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**COAL RESEARCH LABORATORIES
ANNUAL PROGRESS REPORT 1985-1986**

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ENERGY RESEARCH PROGRAM
COAL RESEARCH LABORATORIES
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FOREWORD

The fourth year of the Coal Research Laboratories (CRL) has been marked by an increasing emphasis on the twin processes of consultation with industry and technology transfer. Industry-wide seminars to review research needs and laboratory programs were hosted by each of the component laboratories in addition to formal conferences organized jointly by CRL and regional universities. The topics covered by these meetings included Surface Mining Equipment Selection, Methane and Coal Dust Explosion Hazards, Mobile Pilot Plant for Coal Preparation and Water Treatment in Coal Preparation Operations. In addition, the annual preparation of long term research plans lead to a widespread telephone review of research with over twenty western Canadian companies involved in application of bitumen/water emulsion technologies.

Changes in the organization and programs of the Coal Research Laboratory continue. The Devon Coal Research Centre is now fully operational and indeed was officially opened by Minister of State for Mines, Robert Layton, in September 1985. Plans are already well advanced for relocation of the Calgary laboratory to Devon.

A planning document outlining a consultative process for the Surface Mining Laboratory - as the Calgary laboratory will be known following relocation to Devon in July 1986 - has been circulated to the Western Canadian coal industry. This lays the groundwork for the continuous communication with industry that will be essential to the new programs of the relocated laboratory.

These activities have all consolidated the existing avenues for dialogue between the Coal Research Laboratory and its industrial clients.

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MICROMEDIA

AVANT-PROPOS

La quatrième année d'activité des Laboratoires de recherche sur le charbon (LRC) a été marquée par l'importance accrue attribuée au mécanisme de consultation bilatéral avec les représentants de l'industrie et au transfert de la technologie. Des séminaires portant sur la détermination des besoins au niveau de la recherche et des programmes réalisés en laboratoire ont été organisés au profit de tous les secteurs de l'industrie par chacun des laboratoires constituants en sus des conférences régulières organisées conjointement par le LRC et les universités régionales. Les sujets couverts au cours de ces réunions comprenaient la sélection de l'équipement d'extraction minière à ciel ouvert, les risques d'explosion inhérents au méthane et au charbon, l'usine-pilote mobile utilisée pour la préparation du charbon et le traitement de l'eau pendant les travaux de préparation du charbon. En outre, la préparation annuelle des plans de recherche à long terme a donné lieu à une enquête téléphonique d'envergure à laquelle plus de vingt sociétés de l'Ouest canadien oeuvrant au niveau de l'application des techniques relatives aux émulsions bitume-eau ont participé. Les programmes et l'organisation du Laboratoire de recherche sur le charbon font encore l'objet de modifications. À l'heure actuelle, le Centre de recherche sur le charbon de Devon, qui a d'ailleurs été inauguré officiellement en septembre 1985 par M. Robert Layton, ministre d'État (Mines), fonctionne à pleine capacité. Le projet de relocalisation du laboratoire, de Calgary à Devon, est déjà très avancé.

Un document d'étude donnant un aperçu du mécanisme de consultation dont sera doté le Laboratoire d'exploitation minière à ciel ouvert - nom officiel sous lequel sera désigné le Laboratoire de Calgary après sa relocalisation à Devon en juillet 1986 - a été diffusé au niveau de l'industrie du charbon de l'Ouest canadien. Ce document présente les lignes directrices ayant trait au mécanisme de communication continue avec l'industrie, mécanisme qui sera essentiel à la réalisation des nouveaux programmes du laboratoire, une fois la relocalisation complétée.

Ces activités ont contribué à consolider les mécanismes actuels de communication entre le Laboratoire de recherche sur le charbon et ses clients en provenance de l'industrie.

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HIGHLIGHTS

CAPE BRETON COAL RESEARCH LABORATORY

The commencement of FY 85-86 coincided with a return of the Laboratory to permanent, renovated premises at 210 George Street Sydney, Nova Scotia. The facility is seen as providing Canada with technical expertise from a team of longwall coal mining researchers.

The renovated premises provide an excellent base for the dominantly field oriented activities of the Cape Breton Coal Research Laboratory (CBCRL). There remain some items of equipment to be completed and some to be purchased but it is anticipated that such purchases and completion will be finished during 1987.

The Laboratory is now in a strong position to pursue in a productive mode the understanding of field observed phenomena and to assist in the resolution of operational problems and difficulties. Its main client will remain the Cape Breton Development Corporation (CBDC) but its continuing existence signals that it can and will transfer technology to Western Canada, if and when necessary.

A significant event for the Cape Breton Development Corporation was the commencement of the drivage of the first two of the underground slopes (deeps) at the Phalen Mine during November 1984. By August 1985 all equipment for the development of the five main slopes (deeps) for this new developing mine had been commissioned. By September 1985 field data collection had been completed by this Laboratory on a cooperative equipment trial with Cape Breton Development Corporation.

CALGARY COAL RESEARCH LABORATORY

This year marks the start of transition for the Calgary Coal Research Laboratory. As a result of reorganization within the Coal Research Laboratories (CRL) and the changing nature of the Canadian coal industry, Calgary CRL has:

- a) redirected its R & D programs from underground - specific to surface mining oriented technologies,

- b) restructured to include Operations Research, Advanced Surface Mining Technology, Geotechnical Engineering and Environmental Control sections.

In the current year excellent progress has been made on a number of inhouse and extramural projects. Resource limitations have restricted field activities but that shortage of travel funding has been offset by increased use of seminars and other mechanisms of technology transfer to industry.

Two interactive computer models of surface mining equipment were developed: truck-shovel-loader and BWE-conveyor-bin. These models are now being validated using field data from 8 surface coal mines in western Canada.

On the subject of spontaneous combustion problems, Calgary CRL carried out studies at Quintette and Obed Marsh mines and provided necessary information and expertise on the prevention of fires which was appreciated by mine management. Work on methane accumulation in storage silos was completed and the results presented to the Alberta Mines Safety Branch, an Explosion Seminar at the University of Alberta, and to industry.

During the year the telemetry equipment was moved from the Westar coal mine to the Syncrude oilsands mine for monitoring the stability of highwall benches where draglines are in operation as well as for monitoring the stability of the tailings dam.

Work on rock characterization continued with the investigation of different techniques available. A correlation between the point load strength and uniaxial compressive strength for soft rocks was established.

A computer based theory of strength of pillars in coal has been verified through laboratory tests of coal properties. This method can be used for designing pillars in soft rocks.

A study on resin bolts has provided a thorough evaluation of the mechanics of layered roof supported by non-tensioned resin bolts. This will have applications both in surface and underground mines.

Significant progress on field studies related to the selection and optimum utilization of surface mining equipment, alternatives for material handling, solutions to the problems of high rolling resistance and cold temperatures, and evaluation of bucketwheel excavator performance in oilsands mining has been made and reported.

Calgary CRL jointly with the University of Calgary organized a symposium on "Mining Equipment Selection". It was attended by 175 delegates, was very successful, and will be repeated for other subjects next year.

A coal map file was produced. This comprehensive piece of work contains relevant information on the coalfields of Canada with respect to geology, mine locations, infrastructures, transportation routes, coal quality etc.

In view of the continuing shift to surface coal mining activities in western Canada, Calgary CRL's research program is being modified. The only underground related work scheduled for future years is related to the AOSTRA Underground Test Facility (oilsands).

EDMONTON COAL RESEARCH LABORATORY

Early in 1985 the Edmonton laboratory hosted an industry-wide seminar to discuss the capabilities and opportunities for use of the three mobile pilot plants operated by the coal preparation research staff. Following that meeting all three units remained in the field to carry out both research experiments and to offer cost-recovery assistance services to a number of plants. A paper describing technical and economic results from a previous program of this sort was amongst the CRL presentations to the Western Canadian industry at the "Open-Pit-Operators Conference" sponsored by CIM at Hinton in September.

The Operators Conference also served as an introduction to the formal opening ceremony for the Devon Coal Research Centre which took place on September 13th, 1985. The Honourable Robert Layton (Minister of State for Mines) and the Hon. Don Sparrow, Associate Minister of Public Lands and Wildlife in the Department of Energy and Natural Resources, Alberta formally opened the building. In the company of some 200 guests who were members of federal and provincial parliaments and regional industrial and academic representatives, the two ministers were able to take the opportunity to tour the facility and review the research programs of the three occupants.

The opening ceremony also coincided with the milestone publication by a staff scientist of a book describing the development and application of NMR spectroscopy to fossil fuel studies. This text is an outcome of laboratory research and its enthusiastic reception in the international scientific

community confirms the laboratory's leadership in the application of this sophisticated structural analysis technique to coal technology.

The coal preparation pilot plant completed a major project on behalf of the maritime coal industry in its evaluation of the optimum circuit specification for three maritime coals. These "in-house" results paralleled an investigation conducted under contract at the Electric Power Research Institute Facilities at Homer City (U.S.A.). The continuing analysis of data from these programs is expected to lead to quantitative correlations between the performance of the leading U.S. and Canadian pilot facilities.

At the end of the year plans were well advanced for the Xth International Coal Preparation Congress which is sponsored by Energy, Mines and Resources Canada and will be held in Edmonton in September 1986. CRL staff are playing the leading role in the planning and implementation of the technical program.

CAPE BRETON COAL RESEARCH LABORATORY

**CAPE BRETON COAL RESEARCH LABORATORY
RESEARCH AND DEVELOPMENT**

ADVANCED TECHNOLOGY

The objective of the Advanced Technology Group is to improve the safety, productivity and resource recovery of Atlantic underground coal mining through the introduction of improved technology, equipment and techniques.

Frictional Ignition Control

The Frictional Ignition Working Group (members drawn from Labour, Management and Regulatory groups) continued to meet throughout the year. From its forum came proposals for further trials to determine the performance of hollow shaft ventilators and for surface trials on the water pressure flow characteristics of hollow shaft ventilators and for the standard drums supplied for the shearers.

Hollow shaft ventilators employ the venturi principle to induce an air flow in the zone around the face plate on the drum of a shearer. The hollow drum shafts on a shearer are each equipped with a jet of a specified small bore diameter and a suitable aerodynamic characteristic. Such a jet can be positioned appropriately in the bore of the hollow shaft. An airflow is induced by the transfer of the dynamic energy of the high velocity water particles that issue from such a jet into the orifice of the hollow drum shaft.

The purpose of the induced air flow is to dilute to below the lower explosive limit any methane released from the coal cut by the shearer drum. The volume of air flow produced by hollow shaft ventilators to adequately dilute methane must be at least $0.28 \text{ m}^3/\text{s}$ ($10 \text{ ft}^3/\text{s}$).

The first trial on hollow shaft ventilators was performed on the shearer on 6 West Longwall District at Lingan Mine with the hollow shaft ventilators being supplied from the district water main at a pressure of approximately 25 bar (360 psi) to the shearer body. With all the water diverted solely to the hollow shaft ventilators a maximum air flow of $0.02 \text{ m}^3/\text{s}$ ($0.7 \text{ ft}^3/\text{s}$) was recorded.

For the second trial the shearer incorporated a booster pump with pressure flow characteristics in a range of 1.5 l/s (0.3 gal/s) at a pressure of 35 bar (500 psi) to 0.9 l/s (0.2 gal/s) at a pressure of 103 bar (1500 psi). At a pressure of 103 bar the maximum recorded air flow on each shearer drum was approximately 0.042 m³/s (1.5 ft³/s).

From a consideration of these results the Frictional Ignition Working group requested CBDC to conduct a surface trial on a shearer to be installed with a provision for adequate flow pressure capabilities. Such a trial was conducted on a fully reconditioned shearer in the surface shops at the Prince Mine. The shearer was to be commissioned in the 6E Longwall District at that mine. Water was supplied by a three piston Fletcher Sutcliffe Wild pump of a type suitable for supplying circuits for hydraulic powered supports. Pressure adjustment could be made by an unloader valve.

The hollow shaft ventilators were supplied with flows in a range of 2.42 l/s (0.53 gal/s) - 2.19 l/s (0.4 gal/s) at corresponding pressures of 32.7 bar (475 psi) and 172.4 bar (2500 psi). A maximum performance was attained at the latter flow pressure conditions by each hollow shaft ventilator of 0.085 m³/s (3.0 ft³/s) for the left hand drum and 0.11 m³/s (3.75 ft³/s) for the right hand drum. The maximum performance attained 0.11 m³/s (3.75 ft³/s) represents only 37.5% of the recommended minimum flow for adequate dilution of methane. The pressure applied to attain such a performance greatly exceeds that recommended for the piping system on a shearer.

Shearers used by Cape Breton Development Corporation are fitted with standard drums of diameter of 1.5 m (60 in.) and a width of 0.74 m (29 in.). The face plate has 18 picks and each of three vanes has six picks to a drum total of 36 picks. Behind each pick a face flushing nozzle and a back flushing nozzle is provided to a total of 72 nozzles per drum. These nozzles have a diameter of 0.8 mm (1/32 in.), are manufactured in brass and are easily replaceable.

The trials on the shearer drums were conducted through a range of flows and pressures. Initially they were made with both drums receiving water and were then confined to one drum only.

A satisfactory flow pressure condition was obtained on one drum at a flow of 2.65 l/s (0.58 gal/s) and a pressure of 62 bar (900 psi). The nature

of the trials were subjective but at this flow pressure condition those nozzles in a vertical position projected a jet stream 2.13 m (7 ft) into the air beyond the drum perimeter, and flow from the nozzles could not be blocked. This suggested that in normal operating conditions on a face this pressure would maintain the nozzles free from blockage. The water flow during this particular trial approached the recommended minimum flow of 0.04 l/s for an adequate reduction in the probability of frictional ignitions.

To attain such flow pressure conditions on an operating longwall face would require either two three-piston pumps or one five-piston pump of commensurate design and specification to the one used for these trials with a water hose system dedicated solely to the drums. Consideration should be given to operating shearers in such a mode as it would provide a visible and effective anti-ignition component.

The Frictional Ignition Working Group is also currently considering a proposal for a further detailed trial of polycrystalline diamond tipped picks submitted by this Laboratory.

Water Jet Assisted Roadheaders

During a four-week period in August-September 1985 a cooperative trial was made with the Cape Breton Development Corporation on a Dosco MkIIb roadheader that was newly commissioned to drive the top portion of the No. 4 slope (deep) at the Phalen Mine.

The slope (deep) has a cross-sectional area of approximately 17.7 m² (190.5 ft²). It is supported by U-shaped steel arches of a floor width of 5.5 m (18 ft) and a crown height of 3.75 m (12.25 ft). The lower portion of the face of the slope (deep) is in the Phalen seam. With local variations in seam height and gradient the material at the face of the slope (deep) varied between 28%-61% rock that included soft siltstones, sandstones and mudstones with the remainder being the coal of the Phalen seam. The average gradient on the slope (deep) was approximately 1 in 4. The purposes of the trial were to investigate the effect of varying water pressures and flow rates upon the release of airborne respirable dust and machine cutting performance.

A series of cuts were taken at the slope (deep) face of approximately equal volumes. A similar pattern of operation of the cutting head was adopted for each cut. Each series of cuts was made at controlled pressure

and flow rates between 69 bar (1,000 psi) and 345 bar (5,000 psi) at increasing increments of 69 bar (1,000 psi) with additional series of cuts being made at 690 bar (10,000 psi) and by cutting dry.

The dust produced was measured for each cut at a fixed control point with the following suite of instruments:

- a) A SIMSLIN II Dust Monitoring System
- b) Casella Gravimetric Samplers 113A
- c) Three or four Rothroc and Mitchell Cyclones equipped with 0.8 m Nuclepore Corp. Membra-Fil Filters.

The gravimetric respirable dust sampling instruments were started and stopped coincidentally with the face cutting activity. Time lags due to residence time within the slope (deep) ahead of the control point were determined by the SIMSLIN concentration-time profile.

The results of this trial gave an optimum pressure of 155 bar (2,250 psi) for a cutting excavation rate of $0.6 \text{ m}^3/\text{min}$ ($0.78 \text{ yd}^3/\text{min}$). From discussions held with other overseas research organizations this result is consistent with their findings. Beyond pressures of 207 bar (2,000 psi) there was a steady increase in the specific weights of dust produced/ m^3 cut from approximately 50 g to 185 g at 690 bar (10,000 psi). It was inferred from these results that the increase in dust levels from the optimum water jet assist pressure could be the result of the application of the combination of the cutting head and water assist energy levels exceeding those levels necessary for the breakout requirements.

A trial to establish optimum total energy levels is being sought by this Laboratory.

Risk Assessment of Fire and Wood Substitutes

A contract was awarded in September 1985 to Jacques Whitford and Associates for an investigation into risk assessment of underground fires in Cape Breton coal mines and wood substitutes.

CBDC has, during the current year, made extensive enquiries into the fire retardant treatment of wood. There is still an abundant use of wood for lagging roadways in CBDC collieries.

CBCRL is endeavouring to promote nonflammable substitute materials for wood. The investigation by Jacques Whitford and Associates has been

directed to review all known substitutes for wood for all purposes in coal mines. The contractor has been directed to review in particular materials that are available within the Maritime provinces.

Water Jet and Water Jet Assist Technologies

An agreement was reached with the International Energy Agency (IEA) in London, England to undertake a review report on the potential uses, benefits, disadvantages, and any connected health and safety risks that might be associated with water jet and water jet assist technologies in underground coal mines. Two meetings have been held with representatives of the IEA. It is expected that the report will be completed in September 1986. In the meanwhile this Laboratory is maintaining a close liaison with the IEA.

Technology Reviews

In addition to fire risk assessment, wood substitutes and water jet and jet cutting technologies, Advanced Technology staff has prepared in-house reviews on power requirements and duties of shearers with water jet assist features, and the common features of highly productive retreat longwall mines.

STRATA MECHANICS

Gob Leakage and Gateside Pack Performance

Most of the internal laboratory and field work of the Strata Mechanics Group was directed at the problems of gob leakage and gateroad support.

In March 1985 CBDC installed a monolithic pumped packing system on the 9E Maingate at Lingan Colliery. CBCRL assisted in the design of the pack, based on their previous field work, and monitored the effects of the packing change on gateroad support and gob leakage. In summary, the new method of packing maintained gateroad stability whilst improving the gob resistance by 1000%.

Towards the end of 1985 problems were encountered with support in the pump packed gateroad, but this has been attributed to poor quality control of the monolithic pack mixture. Incorrect mix proportions have been identified as the prime cause of these support capacity problems.

The monolithic pumped packing system currently in use is the 'Astrapack' system. Despite its beneficial effects, it is more costly than the wooden packs traditionally used. One reason for this is that the material is a specially-treated import from the U.K. CBDC and CBCRL are therefore investigating the feasibility of using materials indigenous to Nova Scotia in gateside packing. Two possibilities are flyash/cement concrete and pneumatically stowed anhydrite. Both are used in Europe to good effect, and both are available in Nova Scotia at substantially lower costs than the imported material.

The support of tailgates has long been a problem at Lingan Colliery. The basic problem is that the traditional dirt and wood packs gave inadequate support to control the gateroad. After several meetings and discussions on pack design modifications between CBDC and CBCRL staff, a new pack design resembling the conventional maingate pack was introduced in the 6W District as it opened in late 1985. The new packing method was successful in maintaining the tailgate. After a few weeks it was also introduced in the 9E Tailgate. Thus a direct comparison of the two packing methods was possible. Gateroad deformation was substantially reduced, resulting in a 10% increase in height. This allowed easier ventilation and transportation in the gateroad. The system will now be the standard tailgate pack design.

Barrier Pillar Design Criteria

Work continues on the development of barrier pillar design criteria. Data is collected regularly and added to the information base currently being analysed by McGill University under an EMR RAP grant. A status report has been prepared and submitted to the Laboratory.

Instrumentation Development

Trials were carried out with the Interfels mechanical readout pressure cell. In this instrument, pressure on the cell results in a piston being extruded from a transducer housing. The pressure on a mine support can thus be measured with a dial gauge, the piston extrusion being directly calibrated against stress. The cell performed exceptionally well, represents no increase in costs, and is easier and quicker to read than the conventional hydraulic readout cell previously used.

Rock/Gas Outbursts

Since 1977, thirty-seven events identified as outbursts occurred in the No. 26 Colliery workings below a depth of 700 m. The early events were described as roof falls because of their docile nature and because no methane emission was recorded. However, the two most recent events in November 1983 and January 1984 were particularly violent and resulted in the temporary halt of further 'main deeps' development until a method of control could be implemented. The November 1983 occurrence demolished 18 arches, ejected 300 m^3 of rock and over 750 m^3 of methane. The January 1984 occurrence demolished 16 arches, ejected over 150 m^3 of rock and almost 3200 m^3 of methane.

The ejected material consisted of pulverized fine/medium grained sandstone. The outbursts only occurred where the overlying sandstone unit came within 2.7 m of the top of the coal, the development roadway was being driven using 'drill and blast' methods and the depth of cover exceeded 700 m. Research to investigate the outburst phenomena experienced at No. 26 Colliery has continued following closure of that colliery since other CBDC operations are expected to reach similar depths and geological environments within the next five years. A contract undertaken by Associated Mining Consultants Ltd. revealed that hydrofracturing techniques could be used for combatting outburst phenomena within the Sydney Coalfield. The final report demonstrated that the basic hardware for drilling directional boreholes, blending and pumping fracturing fluid and controlling methane flows is already available, although some modifications would be necessary to conform to permissible requirements. However, the major problem is still to define the outburst prone sandstone in terms of geometry, state of stress and geotechnical properties. Once this information becomes available an optimum hydrofracturing scheme can be designed.

To obtain further information for the outburst research program, a detailed series of in situ stress determinations have been undertaken at the Langan and Prince mines. The program involved both USBM overcoring and minifracturing in situ stress determinations in as many different lithological units as possible. In addition, the program has allowed a preliminary evaluation of minifracturing techniques in the underground coal mine environment and the determination of its performance in weak coal measures strata such as coal and mudstone. Field work on the project started in September 1985, with

the completion of the Prince mine site in November 1985 and the Lingan site in February 1986. The contract was undertaken by Golder Associates.

Evaluation of Submarine Subsidence Guidelines

Existing guidelines for the safe working of undersea coal reserves indicate that between 8.75 mm/m (N. America) and 10 mm/m (U.K.) of tensile strain associated with subsidence development can be induced at seabed before the risk of water occurrence to the mine workings becomes unacceptable. In the United Kingdom, a minimum of 105 m of coal measures strata is required between the working seam and the base of a major aquifer horizon or seabed, while in the U.S.A. a minimum of 60 m of cover is required for every 1 m of extracted seam height.

The applicability of existing undersea subsidence guidelines to the Sydney Coalfield is uncertain since they were derived primarily from European land truthed data which has been extrapolated to undersea conditions rather than derived empirically from seabed truthed data. CBCRL has therefore initiated a long-term program to measure actual seafloor subsidence development, produce effective predictive techniques and establish safe working guidelines for the Sydney Coalfield.

During the year, work has continued on the evaluation of a seafloor subsidence monitoring system suitable for use in the Sydney Coalfield. Discussions with various research organizations has indicated that a seafloor instrumentation scheme could be designed, constructed and installed, although initially data for only one longwall panel would be obtained. An alternative scheme currently under consideration is the use of geophysical techniques to identify the presence of historical seafloor subsidence profiles over the existing Prince, Lingan and No. 26 mine workings.

Additional work has continued in the area of subsidence profile prediction. Five different prediction programs are currently operational on an IBM-AT computer and further evaluation of these programs is planned using both theoretical and actual case histories from the Sydney Coalfield and other coalfields in the U.S.A. and U.K.

Rock/Support Interaction

In December 1984, the Lovat full face TBM completed its driveage of the Donkin-Morien No. 2 tunnel. The TBM advanced 3350 m in 11 months. An extensive geotechnical program, resulting from the submission of an unsolicited proposal (awarded to Golder Associates in February 1983) and undertaken in conjunction with CANMET and CBDC was completed and the final report submitted in January 1986. The final report represents a comprehensive data summary of the complete program and contains all of the routine geotechnical and tunnel driveage data. The results of the report were disseminated to industry via two debriefing seminars held in Sydney, N.S. and Ottawa in February 1986. Additional presentation of the results is expected to continue via conference and seminar presentations as well as journal publications.

In early 1985, CBDC undertook an in-seam driveage within the Harbour seam at the end of the complete No. 2 tunnel in order to obtain a bulk coal sample for large scale testing. The 127.5 m long driveage was supported by rectangular steel sets of a width of 5.5 m and a variation in height between 2.5 and 3.4 m. Four comprehensive instrumentation arrays were installed within the bulk coal driveage and monitored for both short and long-term rock response. Additional monitoring was also undertaken on experimental roof bolt problems used to establish the feasibility of using roof bolts instead of steel sets in future mining operations.

A limited program of in situ strata gas permeability testing was also undertaken in sections of a borehole drilled across from the No. 3 to the No. 2 tunnel. This work was undertaken to augment in situ strata modulus data obtained in close proximity to the tunnel sidewalls in order to compare the effects of the two excavation methods on the strata integrity. Drill and blast techniques were used to drive the No. 3 tunnel, while a full face tunnel boring machine was used to drive the No. 2 tunnel.

In February 1986, driveage of the No. 3 tunnel using the Lovat 7.6 m. diameter TBM began. A geotechnical monitoring program has been drawn up in consultation with CBDC and a series of extensometers will be installed to assess those areas with potentially bad ground conditions that are projected for the tunnel driveage.

Other Projects

Current CBCRL research programs have demonstrated a need for rock strength testing for various strata types encountered in the Sydney Coalfield. Since CBCRL's rock testing facilities are not yet fully operational, a program of irregular sample point load testing was initiated to establish a preliminary geotechnical data base. Uniaxial compressive and tensile strength values were calculated from the point load index tests both parallel and perpendicular to the bedding plane and an anisotropy index calculated.

This program has been extended to coal obtained from the Harbour seam, Donkin-Morien mine. In addition, a more detailed analysis is being undertaken on further samples collected from the Prince and Langan mines.

Hydrochemical and water inflow data obtained from the Donkin-Morien No. 2 and No. 3 tunnels was analysed, the results presented to CBDC and a paper prepared for and presented at the International Mine Water Congress, Granada, Spain, September 1985. Ongoing activities have been restricted to the development of data handling facilities. An IBM compatible computer program has been written which enables hydrochemical data to be processed and plotted using Durov diagrams.

Rock Mechanics Laboratory

The Rock Mechanics Laboratory is now nearly operational. A malfunction in the core drill is under repair at the manufacturers. A stiff load frame will be fabricated in FY 86-87 for \$13K, giving a test facility in addition to the MRL Tinus Olsen frame due to be on site in early 1987.

Laboratory storage space has been improved with the addition of storage shelves and core storage racks.

COAL MINE ENVIRONMENTS

Gob Leakage

CBCRL continued its study of gob leakage from the previous year. In March of 1985 a monolithic pumped packing system was introduced on 9 East intake gateroad at Langan Colliery. A total of eight ventilation surveys were conducted to determine the effectiveness of the new pack. A new technique was perfected using tracer gas to accurately define the airflows around the longwall district and calculate the increase in the gob's resistance. It has

been determined that monolithic packing produces up to a 1000% increase in the resistance. Computer simulations have shown that, if used throughout a longwall district, it will reduce the leakage to an acceptable level; thus allowing a 2600 m face advance to be completed without utilizing other leakage control methods.

Shotcrete sprayed along 9 East intake gateroad was also evaluated using this same technique. It was shown to produce a temporary small improvement which became ineffectual as leakage returned to almost its original level, as the shotcrete cured and cracked due to shrinkage and time dependent ground movement.

Other Tracer Gas Applications

A major thrust of CBCRL's ventilation research is the continued development of tracer gases for solving complex ventilation problems. To achieve this, CBCRL has developed a range of tracer gas techniques and applied them in many novel ways. In this past year tracer gas has found the following new application in the Sydney Coalfield:

- a) Calibrating measurement systems in the Lingan Colliery surface methane drainage plant,
- b) rapid measurement of a main mine fan's operating point with a view to simplifying a complete fan test at a later date,
- c) determination of the leakage characteristics of a long, auxiliary-ventilated dead-end roadway.

To improve the flexibility of the tracer gas technique, CBCRL has been developing instrumentation in-house which can be used to measure tracer gases in the underground environment. One of these instruments was given a field trial in the uranium mines near Elliot Lake where it performed very well. Experiments were conducted to measure slope residence times. Using the instrument to provide rapid sequential sample analysis underground a level of information was obtained that had previously been impossible. The field trial also confirmed a theoretical relationship between the slope airflow and residence time and allowed a transfer of the tracer gas technology to Elliot Lake MRL researchers.

A contract let to McGill University showed that although SF_6 can be collected on adsorbent charcoal cloth, it is also affected by too many of

the variables commonly encountered in an underground mine to make it suitable as a sampling medium. Plans to develop an automated tracer gas sampler have therefore been re-directed to focus on a grab sampling system.

Other Projects

Assistance was also given to the Advanced Technology Group in their studies on the performance of Hollow Shaft Ventilators already reported by that group.

CBCRL staff have also been involved with the compilation of a CBDC Standard Practice Manual for the safe, efficient operation of auxiliary ventilation systems. It is hoped that this will improve the standard of such installations in CBDC mines.

Airborne Respirable Dust

A divisional report, ERP/CRL 85-68(CF), was prepared in April and printed in July which describes the ten surveys of mine dust and one test of instrumentation in Langan Colliery longwall districts during the period December 1984-March 1985.

Fixed-location sampling and personal sampling techniques were employed to estimate the miners' exposure to airborne dust and to identify dust sources in each longwall section.

A relationship (with correlation coefficient 0.865) was established relating total respirable dust generated as measured at the control point to coal produced and intake and return gate road advances.

The relationship between control point measurements and personal sampling measurements for various job types is not clear and requires further investigation.

Starting in December 1985, dust surveys were conducted at Prince Mine's 4 West and 6 East Walls. So far four surveys have been made at 4 West including one portal-to-portal sampling and two surveys at 6 East including one portal-to-portal survey. The mean concentrations measured at Prince longwalls are, on average, much higher than those measured at Langan longwalls. Personal sampling is new to CBDC personnel. The success of such sampling will depend on the cooperation of the staff of this Laboratory with the management, supervisors and the working miners at the CBDC.

Two new cascade impactors for dust particle sizing were tested on February 6, 1986 at 6 East control point at Prince Mine. The size range that contributed mainly to mass on the collecting medium of the cascade impactors was between 3 - 7 microns (equivalent unit density sphere).

Instrument Tests in Dust Chamber at Elliot Lake Mining Research Lab

Twelve sets of personal samplers routinely used for field surveys were tested under controlled laboratory conditions to assess their relative performance. For comparison, a pair of standard Gravimetric Samplers and the Simslin II were also tested in the same conditions. Variations among the twelve sets of personal samplers ranged from 4% to 12.5% during six tests. The sets consisting of a combination of the Dupont D-11 pump with the Casella Cyclone C-11 gave large variations and unusually low readings of respirable dust concentrations. The concentrations determined by the personal samplers were higher than those determined by the standard Gravimetric Samplers (of the order of 1.15) but, during the previous Lingan surveys, the average ratio of personal samplers readings to standard samplers readings was 0.9. The discrepancy may be due to the different dust clouds, concentration and sampling times used for these tests as compared with conditions at the Lingan Mine. The ratios obtained for the Prince Mine surveys approached unity.

Mineralogical and Elemental Analysis of Airborne Coal Mine Dust in Lingan

Scanning electron micro-analysis of samples collected by Laboratory staff were analysed by the Atlantic Coal Institute and have shown high quartz content of from 5% to 8% by weight near the face walls and from 11% to 13% by weight near the brushing zones of return gates. These are very preliminary results requiring further studies. Main non-coal elemental constituents of the analysed samples are Si, Fe, Al, Ca, S, Cu, K, Cl, and Ti.

Light Optical Microscopy at CBCRL

Procedures for observation of coal mine dust on millipore membrane filters have been established. The Laboratory is ordering a number of standard minerals for the purpose of comparison and identification of specific minerals in airborne coal mine dust.

New Instrument for Respirable and Total Dust Measurements

Two real-time dust monitors will be added to our field survey instrumentation: (a) Digital-Data from W. Germany, and (b) Miniram from U.S.

Methane

The emission of methane into mine workings is a complex process. The sources of methane extend into zones both super and subjacent to existing workings in areas ahead of, on the flanks of, and behind the existing workings. It is influenced by multiple factors including:

- a) The original gas content of the coal seam.
- b) The vertical intervals between super and subjacent seams.
- c) The depths of mine workings.
- d) The thickness of the seam being worked and those of the super and subjacent seams influenced by the seam being worked.
- e) The geometry and the extent of the workings.
- f) The methods of mining.

The productivity and profitability of mining is dependent on the effective utilization of highly productive plant and equipment concentrated both in space and time. Such a concentration signals the need for increasing rapidities of extraction which in turn intensifies the rates of methane release.

The dilution of methane to acceptable levels by the supply of adequate volumes of air has to be reconciled with an acceptable working environment.

The purpose of methane drainage is to capture methane before it can enter the ventilating currents of the mine from the seam being worked, and from the super and subjacent seams within the working seams' zones of influence both ahead of, on the flanks of, and from behind the workings.

The combined in-house and contract methane research projects has included:

- a) An analysis of Methane Survey Data of the 14th District of No. 26 Colliery.
- b) Methane emissions at Lingan Colliery.
- c) A detailed review and evaluation of CH_4 prediction techniques and their application to Canadian Coal Mines.

- d) Feasibility of using Gaspils and other methods of remotely measuring methane in coal mines.
- e) The design and construction of an apparatus to conduct methane gas studies on Canadian coals.
- f) Operational experience with the Lingan Conspec Environmental Monitoring Systems.

The Lingan Mine is now equipped with a computer based environmental monitoring system. It is expected that the system will be supplemented with methane and air velocity sensors during the next few months. These sensors will monitor the presence of methane by percentage volume on both the intake and return air circuits to and from the longwall faces at that mine, together with the respective ventilation current velocities. This information will be collected by a surface CONSPEC computer and will then be transmitted by a direct data link to a CONSPEC processor within CBCRL. This will provide a valuable data base for the analysis and study of the trends, patterns, and cycles of methane emission.

A detailed face methane survey at Lingan Mine planned in cooperation with CBDC and the USBM to take place during the summer of 1986, will supplement this information.

COAL TESTING

The CBCRL Coal Testing Facility analyzes coal samples for the Nova Scotia Department of Mines and Energy as part of the Joint Federal-Provincial Resource Development Agreement and contributes to CANMET's coal reserve assessment sub-sub activity.

Analysis of Coal Samples

During the year a total of 39 coal samples were analyzed. In addition 199 oil shale samples were prepared for analysis to be conducted by other laboratories. This work is being published in a divisional report.

Canadian Commercial Coals

The Laboratory is presently engaged in the compilation of the CANMET report entitled the "Analysis Directory of Canadian Commercial Coals - Supplement No. 6". The samples were collected during 1984 and analysis of

these samples, the major part of which was done at ERL Bells Corners, is complete.

Coal Data Bank

A contract proposal for the maintenance of the data bank on eastern coals from Nova Scotia and New Brunswick and a computer simulation program of washplant performances at the University of New Brunswick will be put in place early in the new Fiscal year.

CANMET is interested in setting up a "Canadian" coal data bank, possibly located at CBCRL. A new computer system (VAX) has been ordered and is expected soon. The "Eastern Canadian" coal data bank can be incorporated into the aforementioned "Canadian" coal data bank when this computer system is operational.

A.S.T.M. Committee D-5 on Coal and Coke

This Laboratory is represented on the above Committee; attendance was made at two meetings of this Committee during 1985 at Denver, Colorado and Memphis, Tennessee. One of the sub-committees on which this Laboratory is represented is charged with forming standards for peat-fuel analysis of which the Maritime provinces have abundant reserves. No standards yet exist for that type of fuel.

Support of Other Groups within the Laboratory

The Environmental and the Advanced Technology groups have received considerable support during the year from Coal Testing staff in field data collection and subsequent data analysis utilizing the computer facilities available in the Laboratory. The staff has also assisted in software development programs.

EDMONTON COAL RESEARCH LABORATORY

EDMONTON COAL RESEARCH LABORATORY
RESEARCH AND DEVELOPMENT

CARBONIZATION

The Carbonization Unit of Edmonton Coal Research Laboratory has performed pilot plant carbonization tests on Canadian metallurgical coals and coal blends in order to conduct resource evaluation and to improve exporting coal potential. The latter is especially important to western Canadian coals, which are facing increased competition because of soft international markets.

The main activities of this unit are performed in cooperation with the coal companies and steel companies through the Canadian Carbonization Research Association (CCRA). They are summarized in the following paragraphs.

Coking Coal Evaluation

The CANMET carbonization facilities are internationally recognized and are used in cooperation with the steel and coal industries through CCRA. Conventional cokemaking is largely related to the pilot scale coke oven tests on coking coals for resource assessment and characterization studies.

Increase of Coal Bulk Density in Coke Ovens by Means of Increasing Charging Height

This R & D program commenced in 1984. Tests have been carried out to find the following optimized factors: charge height, pipe size, moisture, and coal size. Coke oven tests were performed and the first preliminary results showed negative effects on the coke quality.

Blending of Non-Coking Coal with the Coke Oven Charge

A series of tests was required by a coal company with the objective of increasing the use of non-coking coals. Carbonization research can provide a number of solutions. One of these, blending of coals of different coking properties, has become practised. Pilot-scale tests showed that up to

10% non-coking blend was found to produce weakly bonded coke. Further investigations can be performed when necessary.

Coke Oven Tests on Weathered Coals

One western Canadian coal has been studied in the Carbolite Oven to determine the effects of storage time and temperature on its thermal, rheological, and coking parameters. The second series was carried out on another Canadian coal. The results showed no significant effect on the physical properties after one year. A third series of tests has started at the request of a coal company.

Petrographic Studies

Petrographic studies have been performed in regard to coal utilization, coal dust explosions, evaluation of a char sample of unknown origin, char-making process evaluation, oxidized coal staining and others.

Thermal Rheological Work Using Dilatometer and Plastometer

Routine studies on coke oven charges have been performed by using a dilatometer and plastometer. An additional project regarding a study of oxidation of coals as a function of time has been carried out for a coal company on a cost recovery basis.

Analytical Confidential Reports (Coked at Devon)

- a) Project No. 03-5-1/20-11 (McIntyre)
by John Jorgensen, Allen Lloyd, and Alfred Fung
- b) Project No. 03-5-1/16-47 (Westar Mining)
by John Jorgensen, Allen Lloyd, and Alfred Fung
- c) Project No. 03-5-1/6-28 (Denison Mines)
by John Jorgensen, Allen Lloyd, and Alfred Fung

COAL PREPARATION

Beneficiation Potential of High Sulphur Maritime Coals

As part of a program for the development of beneficiation potential for eastern Canadian coals, three coals (Prince, Donkin Morien, and Minto) were selected for pilot-plant scale evaluation. A bulk sample (70 - 80 t)

from each coal was made available for pilot plant testing at the Coal Research Laboratory facilities at Devon. The objective of the study was to determine the limitations and potential of reducing sulphur content in relation to mass and thermal recoveries. Specific objectives were set in cooperation with interested companies in the Maritimes. Three clean coal samples (5 t each) with different ash and sulphur levels based on the above objectives were made available for combustion testing at the Canadian Combustion Laboratory in Ottawa. Pilot plant results were related to scale up commercial operations in relation to quality of products, size, and coal characteristics. Results from Prince coal correlated favourably with those carried out at the Electric Power Research Institute (EPRI) at Hanover City, Pa., USA on a larger sample (600 t), showing better results with more flexibility in operation of the ECRL pilot plant. Sulphur removal from the three coals ranged between 25% and 70% with corresponding ash content in clean coal of 12% and 1.8% respectively, depending on the coal characteristics and the cut point.

EPRI was awarded a contract to carry out work on Prince coal in order to determine the beneficiation potential and combustion characteristics. CRL acted as Scientific Authority for the beneficiation part while the Combustion Laboratory (ERL) followed up the combustion work.

Beneficiation of Fine Coal

An experimental study is underway to evaluate the feasibility of using spiral concentrators in cleaning fine coal (0.5 mm x 0). Presently, some of the fine coal is misplaced with the refuse in operating plants. The objective of the study is to minimize these losses and improve the overall recovery of fine coal. Two types of spirals are being tested under different operating conditions using different coals with various amounts of coal slimes and clays. Several coal companies are presently interested in the potential of using spirals to optimize the recovery of fine coal.

Development and Design of Pilot Scale Deep Cleaning Facilities

Recent research and development work in several leading coal producing countries is oriented toward lowering ash and sulphur below levels that are presently practical. The objective is to improve coal quality and

reduce environmental hazards. The high quality clean coal can be used for power generation in the form of coal-water mixture. Through a research contract, a review of ongoing research and development on deep cleaning was carried out and followed by designing of a 2 tph pilot scale facility. The new facility will be integrated with the existing versatile pilot plant at Devon. The deep cleaning section includes eight process options and makes the pilot plant facilities unique in the world because of this capability and flexibility. It will be utilized to characterize Canadian coals for deep cleaning, test new equipment, produce coal-water mixtures for combustion and pipeline testing. The deep cleaning section will be built in stages.

Characterization of Canadian Magnetite Resources for Optimum Utilization in Coal Heavy Medium Processes

Magnetite losses in Canadian washeries generally are higher than in other countries. This is probably due to excessive fines in coals washed in Canada. A survey was carried out to determine these losses, magnetite suppliers, characteristics and costs. Favourable response from coal operators has indicated their contribution to the survey and interest in receiving the final report on the study. The study is carried out through a research contract to characterize available Canadian magnetite resources, establish testing procedures, and means to minimize magnetite losses. The findings will be distributed to the coal industry in a report in the near future.

Cost Recovery Work

Obed-Marsh Preparation Plant Performance Evaluation.

CRL staff supervised a sampling program carried out by Obed-Marsh preparation plant staff, advised on required samples and specifications for analysis and calculated performance of specific washing equipment along with material balance flowsheet. CRL, as a third party, reported on results to Union Oil and KHD Company who designed the plant to check against guaranteed performance.

Beneficiation of a High Sulphur Thermal Coal from Vancouver Island.

The project involved optimum cleaning of the raw coal to reduce ash and sulphur. The clean coal sample produced was sent to ERL Combustion Laboratory in Ottawa (CCRL) for combustion testing.

Heavy Medium Control System

The heavy medium circuit and control system were installed last year. Several problems were encountered, some mechanical and others related to control strategy and instrumentation. The mechanical problems were related to desliming of raw coal, rinsing of products and operation of devices. The control strategy was modified to improve the control task on the system due to the time delays inherent in the heavy medium circuit. The new control algorithm proved to be satisfactory. However, more effort in the future will be directed to further improve the reliability and flexibility of the control strategy.

Coal Slurry Pipelining

Canada/Federal Republic of Germany Memorandum of Understanding on Coal Slurry Systems.

The cooperative activities involved four areas:

- a) Dense Coal Slurry Systems (W.A. Warfe). This involved using a 20t sample in preparing dense coal slurry in Germany and carrying out combustion tests on the slurry in Canada.
- b) Hydraulic Transportation of Coking Coal (M.W. Mikhail). A translation of a German (Salzgitter) report on this technology has been circulated to Canadian industry directly and also to CCRA. Limited commentary has been returned to CANMET.
- c) Coarse Coal Slurry Short Distance Pipelining (L. Geller). A contract research program has been completed by Saskatchewan Research Council. The results were discussed last November between Canadian and German representatives. A new phase of work is prepared pending the availability of funds.
- d) Manual of Design for Slurry Pipelines. Environment Canada completed a study on the environmental impact of coal transportation and pipelining. An engineering manual for the design of coal slurry pipeline carried out by the Saskatchewan Research Council is slowly progressing.

Rheology of Coal-Water Slurries

Proper design of coal water mixtures (CWM) preparation facility, handling and transportation by a pipeline requires a thorough knowledge of their rheological behavior. CWM's prepared from two western Canadian coals were evaluated. A model with three parameters gave a good description of the transient behaviour of CWM's. Several rheological parameters such as yield points, shear, and viscosity were determined to characterize the CWM's.

Mobile Fines Treatment Plant

Design of the fines treatment mobile plant was completed by the spring of 1985, initial equipment will be ordered during 1986/87. Based on the design, a work statement was established for future contract work to construct the mobile plant. Cost proposals for construction were much higher than originally estimated. A recommendation was made to install the mobile plant in two phases. The first phase will include the installation of a manually operated plant. Phase 2 will include upgrading of the system at a future date to integrate instrumentation and computer control system. This would enable CRL to achieve the overall objective in stages depending on availability of funds.

Process Control and Computer Applications

The Process Control and Computer Applications Unit worked closely with all other Edmonton Coal Research Laboratory sections, its activities covering a broad range of applied and fundamental R & D.

A major effort was focussed on the development and evaluation of instrumentation for on-line monitoring of various parameters known to be fundamental to the successful control of coal preparation and tar sands/heavy oil extraction processes. Although much of the work is in its early stages, progress was achieved in the development of new instruments and instrument systems for measurement of particle size, solids density, pulp solids contents, oil content and of fine particle surface electrical potentials employing gamma-ray, microwave, fluidized-bed and other techniques. As an integral part of the development effort, work was continued to enable the evaluation of commercially available monitors through acquisition, installation and testing in the mobile and pilot plants. In this regard, testing was

completed for the flotation and medium density control circuits in the pilot plant and the assessment of results is under way.

Progress was made in the development of control strategies, e.g. for clarification and thickening processes in water treatment, the design of techniques for PID controllers and adaptive controllers aimed at automation of operations.

The area of process modelling encompassed both empirical and theoretical investigations, the latter involving a significant element of development of analytical techniques with accompanying software. These techniques will now enable maximum use of various spectroscopies, image analysis, SEM, etc. as applied to the complex physical-chemical systems being modelled, e.g. flocculant-water-particulate, oil emulsions. Continuing statistical analysis of water treatment mobile plant test data has enabled rationalizing the technical and economic performance of a variety of flocculants but has also assisted in the formulation of test methodologies and in providing needed insights regarding process variables and interactions for R & D planning.

In the field of Computer Applications, software support and development was provided to many members of ECRL. This included data analysis, programming in several languages, and interfacing of various microcomputers with the central laboratory computer.

Mobile Water Treatment Plant

The mobile water treatment plant was used in one washery with the objective of improving the performance of their water treatment circuit. The experimental design was intended to (i) determine optimum flocculants(s) dosages; (ii) evaluate flocculants on a cost and performance basis; (iii) monitor the performance of the washery thickener during the field testing period. Results from the field tests will help in better understanding the operation of their water treatment circuit. This information will guide in selecting suitable flocculant(s) which will result in improving the performance of the water treatment circuit and reduce flocculant cost.

Mobile Dewatering Plants

The construction of a second mobile dewatering plant was completed and the plant taken to one washery for field testing. The purpose of field

testing was to debug the unit, and optimize the performance of the major equipment (belt filter press and screen bowl centrifuge). Due to many problems it was only possible to debug the unit this year; the remaining work will be completed in the next year. The disc filter (Dewatering plant no. 1) was loaned to Luscar-Sterco Ltd. for dewatering the product from oil agglomeration/flotation test program at their Coal Valley wash plant.

HEAVY OIL/BITUMEN EMULSION TREATMENT

In the in-situ recovery of bitumen, the formation of oil-water emulsions presents a serious problem. The necessity of separating such emulsions arises from environmental concerns and from the need to maximize product yield. ECRL is involved in the treatment of oil-in-water and water-in-oil emulsions and effluent waters produced from the in-situ recovery of tar sands and the enhanced recovery of heavy oils. One aspect of ECRL's activity in this field will be a 70 barrel/day emulsion treatment mini-plant, which will include such oil-water separation equipment as a free water knockout vessel, dual polarity electrostatic treater, evaporation dehydrator, induced gas flotation unit, and others. Components of the mini-plant, including process monitoring instrumentation, has been purchased and a variety of flowsheet options have been developed. The plant will be constructed under contract, with completion scheduled near the end of the 1986/87 FY, and preliminary testing expected in early 1987.

Fossil Fuel Science and Applications

This section is involved primarily in laboratory-based R & D in fossil fuel science. During the 1985/86 FY, there was an increased level of cost recovery activity in the laboratory, involving areas such as upgrading of lignite, characterization of pitches, tar sands emulsions, and others. There has been a trend toward multi-disciplinary approaches to practical industry problems brought to the attention of CANMET. Instrumental methods applied to characterization of samples provided by the energy industry include NMR and FTIR spectroscopy, scanning electron microscopy, and numerous analytical techniques such as liquid chromatography, ion chromatography, etc. The development of all of these facilities has resulted in a world-class laboratory for fossil fuel science at ECRL.

The Microstructure Laboratory

The techniques available in the microstructure laboratory, including scanning electron microscopy, mercury porosimetry, surface area measurements and gas sorption/desorption studies, have been used in the on-going study of coal oxidation. Coal oxidation impacts on many aspects of both coal beneficiation and utilization. Many projects have been initiated with industry studying the effects and changes in coal microstructure and how it relates to things such as froth flotation, coking properties, and coal dustiness. A thorough understanding of coal behaviour is only possible through study of the microscopic properties of the coal and how they relate to the bulk properties which are of industry concern.

The cryogenic capability of the scanning electron microscope has been utilized in several studies of tar sands emulsions. It is possible, not only to study the morphology of these systems, but also to use x-ray analysis in order to determine the emulsion composition. The use of x-ray analysis is only possible with the existing capability of direct observation of emulsions (as opposed to the study of replicas). The study of clay interactions with the oil and water phases of these tar sands systems is a vital aspect in understanding their processing behaviour. Direct observation of these systems via the electron microscope is one of the few ways that they can be studied without drastic interference.

Fine Particle Electrokinetics

Research was concentrated on colloidal science aspects of practical systems, such as surface charge densities of high sulphur coal, oxidized and unoxidized coal, field coal and processed coal.

A second major area of study concerned emulsion stability as related to electrokinetic and interfacial properties of bituminous emulsions.

Thermal Analysis Techniques

Several methods of thermal analysis available at ECRL have been applied to a range of practical problems, including thermal degradation of polyacrylamide, the use of thermogravimetric analysis and differential scanning calorimetry to characterize oil sand bitumen fractions, the

characterization of coal with regard to heat content, proximate analysis, and oxidative reactivity, determination of heat capacity of minerals, and the identification of minerals in crude oils or oil/water emulsions. A cost recovery project involved measurement of reactivity of Alberta limestone, which is used as an absorbent of H_2S and SO_2 in a tar sands cracking process.

Nuclear Magnetic Resonance Spectroscopy

At ECRL, NMR is primarily applied to the study fossil fuels and polymers. Fundamental and applied studies involve low rank coal upgrading processes, natural and low temperature (laboratory) oxidation and weathering, maceral characterization and relationship to whole coal properties, and a survey of functional group distribution in coals of most ranks. Polymer applications include flocculation and demulsification mechanisms, polymer characterization, thermal stability, and charge density and charge distribution of flocculants and demulsifiers as correlated with field efficiencies. Other research involves the relationship of clay mineral composition with flocculation processes in washeries, characterization of insoluble organic carbon associated with clay minerals and heavy metal minerals in oil emulsion treatment, and heavy oil upgrading processes.

Emulsion Studies

Demulsification work has continued as in past years, and in addition to screening more chemicals for oil-in-water demulsification has involved testing chemicals for water-in-oil demulsification. Refinements in test procedures and methods of analysis have also been investigated.

Work has recently started in the area of emulsification, and is an outgrowth of work done during the 1985/86 year on tailings pond analysis. This involves examination of the effects of such components as clay and asphaltene on emulsion stabilization.

Raman and Infrared Spectroscopy

Raman spectroscopy has been applied in two principal areas at ECRL. The first is a study of structure and spectra of clay minerals, that is part of an on-going investigation of the interaction between clay minerals and organic compounds. These systems are encountered frequently in industrial

samples, e.g. clays extracted from tar sands. Recently, surface-enhanced Raman spectra of acrylamide, polyacrylamide, and acrylic acid have been obtained; this area of research has helped to elucidate the mechanism of polymerization, the long term objective being control of polymer characteristics through the polymerization process.

Fourier Transform Infrared (FTIR) spectroscopy has continued to be applied to the characterization of a variety of fossil fuel samples, including coal macerals, whole coals of various ranks, lignites (including changes brought about by upgrading), peat, pitches, and others. The photoacoustic detection technique has been developed further and applied to the study of fossil fuels, minerals, and polymers. A significant amount of cost recovery work has involved characterization of industrial samples. Results obtained from FTIR spectroscopy continue to be correlated with those from NMR, SEM, thermal analysis, and other techniques available to ECRL.

CALGARY COAL RESEARCH LABORATORY

CALGARY COAL RESEARCH LABORATORY
RESEARCH AND DEVELOPMENT

COAL RESERVE ASSESSMENT

A Divisional Report entitled "Coal Reserves In Canada: 1985" was published, which updates the estimates of coal reserves in Canada as of December, 1985. Like earlier publications it also contains background information on coal quality, operational details of producing coal mines and those in the planning stage.

The National Coal Reserve Inventory, coal mine productivity data, the mine operators list along with associated technical and economic information were updated in the CANMET Report "Coal Mining In Canada: 1985".

The coal map file covering all major commercial coalfields in Canada was completed under contract. National Topographic Service (NTS) map sheets on a scale 1:50,000 are the basis for the file upon which information on regional geology, mine lease boundaries, mine locations, infrastructures, coal quality, and transportation routes, etc. has been superimposed, using transparent overlays. The map file was well received by the Coal Sub-Committee of the National Advisory Committee on Mining and Metallurgical Research (NACMMR).

Work was initiated on establishing a computerized data file for storing information on coal reserves, production, and productivity. First attempts at writing a coalfield data storage program were made in-house by Calgary CRL staff and later by staff of the Edmonton laboratory. As the programs were written, it became clear that the data structure required was not as simple as first thought and that the greater flexibility of a professionally written relational database was desirable. The data are currently being entered on the Smart system running on a personal computer. This provides ergonomically advanced inputting features and a wide range of statistical/graph plotting facilities.

The manuscript for CANMET Report "Analysis Directory of Canadian Commercial Coals: Supplement No. 6", submitted for publication in March 1986 is the product of a joint effort by several laboratories. All major coal mines operating during 1984 were sampled, with Calgary CRL coordinating the

sampling work. Sample preparation and analysis for western Canadian coals was done by Energy Research Laboratory in Ottawa whereas eastern Canadian coals were prepared and analysed, except for trace elements and certain physical properties, by the Cape Breton Coal Research Laboratory.

Close contact has been maintained and information exchanged with provincial coal authorities and coal mine operators, as both are important sources of data and information, on technological and economic changes affecting the Canadian coal industry.

MINE ENVIRONMENTAL STUDIES

During this year, work was continued on the investigation, demonstration and improvement in the techniques for spontaneous combustion control, environmental monitoring and methane control.

Spontaneous Combustion

Work on the characteristics of western Canadian coals with respect to their relative susceptibility to spontaneous combustion on the basis of crossing point temperature, liability index, and oxygen absorption was continued. A high heating rate and low crossing point temperature indicates that the coal is more liable to spontaneous heating. Liability index calculated as the ratio of heating rate and ignition temperature proved helpful in effectively characterizing western Canadian coals. In general, thermal coals appear to be more susceptible to spontaneous combustion when compared to metallurgical coals. The tests further indicated that thermal coals from the foothills region are more liable to spontaneous combustion when compared to thermal coals obtained from the plains region in Alberta. An interim report summarizing the results has been prepared. Further work with additional coals is now in progress.

The potential for fires caused due to spontaneous combustion is significantly increased when the coal is dried below its inherent moisture. Control of this problem is considered essential for safe handling of thermal coals - particularly those destined for export.

An in depth review of the progress made with regard to the contract R & D "A detailed study of the reaction mechanism of spontaneous combustion with particular emphasis on western Canadian low rank coals" was made jointly with the principal investigator (Dr. Frank Bachelor, University of Calgary)

and an incremental work statement was prepared to amend the contract to include additional studies on the effect of moisture and drying of high moisture thermal coals. Planned completion of phase I work is March 31, 1986.

On request by Denison Mines Ltd., Calgary CRL conducted a study on the coarse rejects at Quintette Mine to ascertain their susceptibility to spontaneous combustion. A written report with recommendations on the safe storage and handling of rejects was provided to the company.

As requested, advice and assistance was given to the Occupational Health and Safety, Mine Engineering Branch, Edmonton during their investigation of the causes of an explosion at a western Canadian coal silo.

Assistance is being provided on a continued basis to Obed Mining Co. with regard to the selection, purchase and installation of a monitoring system in their coal silo for early detection of heatings.

Methane Control

Investigations into methane accumulations within coal storage silos in western Canada were completed. This investigation has shown that hazardous concentrations of methane can occur in all of the silos investigated. The investigation has stressed the need for adequate ventilation and monitoring systems. Presentations of this work have been made to the Mines Safety Branch Occupational Health and Safety, the explosion prevention seminar, University of Alberta and the Society of Mining Engineers of A.I.M.E.

Work continued on the third phase of "Biological Control of Methane in Coal Mines, Coal Silos and Shiploads". It has been possible to isolate and culture methane oxidizing bacteria which can remain active at low pH. Tests on models containing 10 kg coal samples showed that bacterial oxidation of methane emitted from coal is possible provided pH and temperature can be maintained. Effect of changing temperature on bacterial activity is being investigated. Detailed characterization of the methane oxidizing bacteria is also in progress.

Environmental Monitoring

Evaluation and interpretation of the test results obtained from the field trial conducted at Westar Mine with the Conspec system was completed. The project provided valuable experience to the manufacturer, the Westar Mine

management and to CANMET personnel and helped in resolving most of the problems encountered with the newly developed System. A divisional report summarizing the experience along with the recommendations resulting from the field testing was prepared.

AOSTRA-CANMET Co-operative Project On Environmental Monitoring

AOSTRA in consultation with Calgary CRL installed a comprehensive monitoring system for the proposed underground test facility (UTF) near Fort McMurray. After a number of joint meetings it was decided that the tube bundle system based on available technology was best for monitoring of the underground environment. Calgary CRL worked jointly with AOSTRA in determining the monitoring strategy including the choice of sensor locations and interpretation of results obtained from underground monitoring. A work plan was prepared by Calgary CRL and accepted by AOSTRA. Advice was given on a continued basis during selection of monitoring equipment. Calgary CRL staff will continue to provide technical expertise and result analysis to AOSTRA on this project.

STRATA MECHANICS

Due to the gradual closure of underground mines in western Canada, the research activities of the laboratory was directed more towards the surface coal and oilsands mining operations.

Oilsands Open Pit Slope/tailings Monitoring

Discussions were held with the management of Syncrude to identify any potential ground control problems. Two ground stability problems were identified as warranting priority attention namely the security of the dragline working bench and the safety of the tailings dam. The existing monitoring system at the mine was expensive and discontinuous. Previous systems were found unsatisfactory by Syncrude. Calgary CRL's computerized telemetry system that was intended for subsidence monitoring in coal mines was tested at this oilsands mine. The field tests in the vicinity of production dragline indicated that the radio-telemetry system will function in the active mining area containing high voltage power lines and variety of mining equipments. At the tailings dyke, the reliability and transmission range of

the radio transmitter was demonstrated through field tests. Accordingly, the Calgary CRL's telemetry system was installed in the Syncrude open pit mine.

Tiltmeters mounted on the highwall close to the dragline are interrogated from the geotechnical engineers office to reveal any movement that could endanger the operation. The system is fully automated and can take readings, make corrections and store the results at predetermined intervals (see report ERP/CRL 85-96). This system is also monitoring the tailings area of the mine providing information on any lateral movement.

A seminar was organized on the telemetry system in Edmonton, its use demonstrated and training provided to the engineering staff of Syncrude's geotechnical groups. On going work involves the upgrading and maintenance of this system.

Rock Characterization And Test Methods

The work on rock characterization and evaluation of test methods continued from the previous year. The rock classification system work was presented to the 87th Annual General Meeting of the Canadian Institute of Mining and Metallurgy, in Vancouver. This was further discussed with several coal mine operators including TransAlta Utilities, Westar Mining Ltd., Manalta Coal Ltd., Cardinal River Coal Ltd., Luscar Ltd., Denison Mines Ltd., and others.

Co-operative work between CANMET and TransAlta Utilities in the preparation stage will validate a borehole penetrometer technique for Canadian conditions. The main objective is to develop a finite element computer model for evaluating stability of open pit slopes.

The techniques of the point load strength, microhardness, protodyakonov dynamic impact strength and rebound hammer index were investigated for their suitability to rock characterization. The results of the point load strength tests were presented to the Fourth Conference on Ground Control in Mining in Morgantown, West Virginia. The results have shown that a different correlation between the point load strength and uniaxial compressive strength for soft rocks exists. The suitability of the microhardness technique has been reviewed and the work will be presented to the 27th U.S. Symposium on Rock Mechanics. Work on a variety of techniques which show promise for geotechnical engineering purposes in surface mines is scheduled next year.

Coal Pillar Design

Under a research contract a comprehensive laboratory test program was completed to validate the previously developed computer based theory of strength of pillars in coal. This theory is based on the existence of a transition point between brittle and pseudo-ductile states. This laboratory study has given some idea in this direction but field study will be required for confirmation. Technology transfer of this study was through a seminar with the participation of the coal industry. The computer program is considered to be useful for coal and other soft rock mining applications.

Roof Supported By Non-tensioned Resin Bolts

This project carried out under a research contract was completed. This work has provided a thorough analytical evaluation of the mechanics of the layered roof supported by non-tensioned resin bolts. The data were evaluated using a finite element computer program. Technology transfer has been through a seminar with the participation of coal and potash mining industry representatives and through presentation in conferences. Practical verification/application of this study may be carried out in surface coal mines and at the Underground Test Facility in oilsands.

Borehole Geophysics

A project on the correlations of downhole geophysical characteristics with geotechnical and hydrogeological conditions for applications in coal and oilsands mining is being developed by the coal and oilsands operators. Calgary CRL at the request of the industry has participated in the development of this project. Point load strength, under study at this laboratory, has been chosen as an important index for this project. Proposals for coal and oilsands projects have been prepared.

Geological Structure

A short review into the possibility of using a computerized mine planning method at the proposed Cardinal river underground coal mine near Hinton, Alberta was completed. The geological issues were examined and the extent of the available (mainly borehole) data estimated. However, given the uncertainty of the future of the mine and the redirection of the focus of this office that modelling project has been placed on hold.

Finite element modelling using CANMET MRL's "sap2d" package was performed to aid in the interpretation of microseismic monitoring data obtained from an active open pit slope. Software was also written to manipulate and plot the data obtained for the microseismic source locations. The aim of this work was to determine whether the geology (as known) would predict area of high stress concentration that might explain the observed microseismic emission pattern. This, was found not to be the case.

Microseismic Monitoring System For Pit Slopes

The field work on the joint project with the U.S. Bureau of Mines (USBM) on the evaluation of a microseismic monitoring system developed by the USBM's Denver Research Center was initiated and completed during the previous fiscal year. The test results are analyzed and documented in CRL's division reports. A report on this work by USBM/CANMET joint authorship is under preparation as a USBM publication.

SURFACE MINING

Several "state of the art" studies were carried out on surface mining methods and the application of mining equipment. The surface mining industry has identified a need for such periodic reviews. Published reports have been well received and numerous request for copies were received from industry and government agencies.

These studies emphasized that mine planning and equipment selection go hand in hand. The prime considerations in equipment selection are the geology of the deposit, project life, production requirement, capital availability, geotechnical considerations, operating cost and resource recovery. Guidelines for the selection of a particular type and class of equipment have been prepared.

In-house work on continuous mining systems such as used in oilsands mining was related to the presentation of a systematic method of evaluating bucketwheel excavator performance in varying geological and mining conditions. This year two reports on this subject prepared in collaboration with Professor Golosinski of the University of Alberta were published.

In the case of surface mineable oilsands, existing mining methods and schemes were analysed. High rolling resistance continues to be a problem

as are the problems associated with cold temperatures. Application of smaller hydraulic bucketwheel excavators and high angle conveyors (HAC) has been proposed. The HACs are highly energy and cost efficient; they can lift material to greater height over short distances and unlike trucks utilize much of the energy in elevating the materials.

For overburden handling, trucks are being extensively used in western Canadian surface mining. However at present competition to trucks is emerging from many types of high speed belt conveyors; this competition is expected to grow. On the one hand, trucks provide the flexibility required in a pit and can operate in confined spaces. On the other, they are capital as well as labour intensive consuming about 50% of the total mine operating costs. Greater use of conveyors is foreseen. A detailed study entitled "OFF-highway Truck Selection in Surface Coal Mining" was prepared providing guidelines on truck selection and utilization including the identification and potential application of recent and emerging technology - a few examples are computer based truck dispatching, inertial guidance systems for "driverless" trucks, health monitoring systems and micro-processor based real time data collection and analysis systems.

A highlight of this year was the very successful symposium on "Mining Equipment Selection" organized jointly with the University of Calgary. Twenty eight papers covering the full gamut of equipment development, selection and utilization were presented to 175 registered delegates.

UNDERGROUND MINING TECHNOLOGY

A contract investigation into the possible application of unconventional mining methods to western Canadian coal seams has been completed. The investigation concluded that there are no truly unconventional mining methods under development at the present time. The new developments taking place are really modifications of existing systems. Of these the most promising would appear to be rib pillar mining, yield pillar mining, ESA shortwall mining and narrow excavation room and pillar.

MINE SIMULATION AND MODEL VALIDATION

During the year, the development of the Calgary CRL computer facility continued with the addition of peripherals. The laboratory took delivery of a plotter and digitiser and software was written to enable these to be used.

A detailed investigation and field study was carried out on the optimisation for maximum production of truck/shovel mining systems in western Canada. Several mines in Alberta and B.C. were selected and relevant information on loading and hauling equipment were collected. The loading and hauling logic was analyzed for each mining property and specific events, such as loading, dumping, truck traffic, maintenance, fueling policies and non-productive events were highlighted.

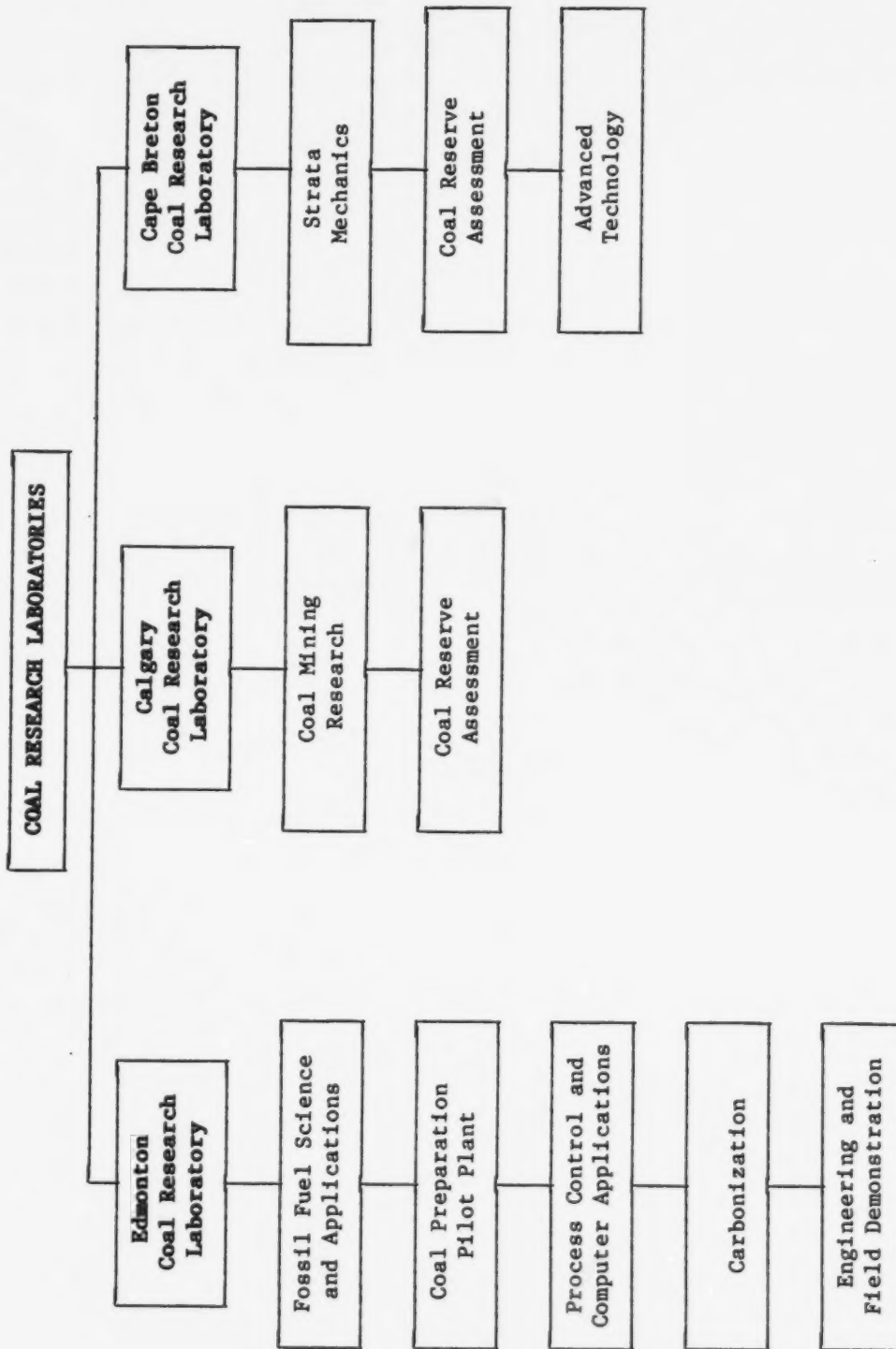
The historical data on production, maintenance delays, availability and utilization of equipment, and other statistical data available from the mines were evaluated and summarized. A computer program was written to search information on loading and hauling equipment from the data file. The selection practices for the above equipment was obtained from the mining companies and equipment manufacturers and analyzed. Detailed reports on the analysis of each mining property and recommendations for optimization are being prepared.

The truck-shovel and BWE-conveyor-bin model joint projects of CANMET, NRC, and Industry continued. The validation of these models continue using actual field data collected at surface coal mines in western Canada.

An AT&T PC was purchased to run programs that have been specifically written by the mining industry and to take advantage of cheap commercial software available for such machines. Examples are the SMART package which is currently being used as a database/graphics package for storing coalfield data and the Caterpillar truck package "VEHSIM".

The laboratory also acquired a development system for the Modula 2 programming language, an advanced form of Pascal. This enables a greater variety of techniques than may be programmed in Fortran and generally encourages a more professional, maintainable code.

APPENDIX A: THE ORGANIZATION OF THE COAL RESEARCH LABORATORIES



APPENDIX B: RESOURCES

RESOURCES

The 1985/86 activities of the Coal Research Laboratories were undertaken under both the Petroleum Supply and Coal Technology Sub-activities of CANMET's Energy Technology Activity. The resources allocated to the division were distributed as shown below:

<u>Sub-sub Activity</u> <u>(and Leader)</u>	<u>Staff Level*</u> <u>(PY)</u>	<u>Budget (\$000's)</u>	
		<u>Operating</u>	<u>Capital</u>
<u>Bitumen/Emulsions Treatment</u> D.K. Faurschou	5	265	200
<u>Coal Preparation</u> N. Anderson	13	373	514
<u>Carbonization</u> J. Gransden	5	50	10
<u>Coal Reserve Assessment</u> A. Romaniuk	6	40	46
<u>Coal Mining Technology</u> D.B. Stewart G. Zahary	22	397	247

*These numbers do not include laboratory management or administrative support staff.

These resources were distributed across the three operating laboratories:

	<u>Budget (\$000's)</u>	
	<u>Operating</u>	<u>Capital</u>
Edmonton	632	710
Calgary	109	59
Cape Breton	265	234
Divisional Support	<u>119</u> 1125	<u>14</u> 1017

APPENDIX C: PROFESSIONAL, TECHNICAL AND ADMINISTRATIVE STAFF

PROFESSIONAL, TECHNICAL AND SUPPORT STAFF

<u>Name</u>	<u>Degrees and Diplomas</u>	<u>Occupational Category</u>
T.D. Brown	B.Sc. (Durham), Ph.D. (Sheffield), C.Eng.	Director
S.D. Ludwar		Secretary
<u>ADMINISTRATION</u>		
C.F. Cameron		Admin. Officer
C.B. Ripper (Devon)		Clerk
V. Keim (Devon)		Clerk
J.I. MacDonald (Sydney)		Clerk
B. Brisson (Sydney)		Clerk
<u>COAL MINING RESEARCH</u>		
D.B. Stewart	B.Sc. (Queen's), P.Eng.	Manager
<u>CAPE BRETON</u>		
G.A. Haslett	B.Sc. (Durham), C.Eng., P.Eng.	Group Leader
C. Spitieris		Secretary
<u>Strata Mechanics</u>		
P.R.M. Cain	B.Sc. (Cardiff), Ph.D. (Cardiff)	Res. Sci.
T.R.C. Aston	B.Sc. (Cardiff), Ph.D. (Nottingham)	Res. Sci.
W.D. Gallant		EG-ESS
L.S. O'Leary		EG-ESS
<u>Environment</u>		
A.W. Stokes	B.Sc. (Nottingham), Ph.D. (Nottingham)	Res. Sci.
C. Hwang	B. Sc. (Taiwan), M.Sc. (Central) M.Sc. (McGill), Ph.D. (McGill)	Res. Sci.
W. Konda	B.Eng. (Hyderabad), Ph.D. (Nottingham)	Phys. Sci.
D.J. Kennedy	B.Sc. (Windsor)	Phys. Sci.
G.W. Klinowski	M.Sc. (Silesian Tech.)	EG-ESS

Coal Testing

G.W. Bonnell	B.Sc. (Dalhousie)	Chemist
D.J. O'Brien		EG-ESS
D.A. Young		EG-ESS
G.R. Corbett		EG-ESS

CALGARY

B. Das	B.Sc., A.I.S.M. (India School of Mines)	Group Leader
J. Stevenson		Secretary

Coal Mining Research

R.N. Chakravorty	B.Ch.E. (Jadavpur), Ph.D. (Nottingham)	Res. Sci.
M.Y. Fisekci	Dipl.Eng. (Turkey), M.Eng. (Sheffield) Ph.D. (Sheffield)	Res. Sci.
N.J. Stuart	B.Sc. (Nottingham), Ph.D. (Nottingham)	Res. Sci.
R.J. Kolada	B.Sc. (Nottingham), Ph.D. (Nottingham)	Res. Sci.

Technical Support

G.H. LaRocque		EG-ESS
K.L. Kar		EG-ESS

Coal Reserve Assessment

A.S. Romaniuk	B.Sc. (Queen's), P.Eng.	Phys. Sci.
H.G. Naidu	B.Sc. A.I.S.M. (Indian School of Mines), P.Eng.	Engineer

Mining Technology

V. Srajer	M.Sc. (U. of Appl. Sci., Kosice), P.Eng.	Engineer
R.K. Singhal	B.Sc. (Nottingham), Ph.D. (Newcastle-on-Tyne), C.Eng., P.Eng.	Phys. Sci.
G. Zahary	B.Sc. (Alberta), M.Eng. (McGill), P.Eng. (On secondment to Program Office)	Phys. Sci.

COAL PROCESSING RESEARCH LABORATORY (EDMONTON)

H.A. Hamza	B.Sc. (Cairo), Ph.D. (Newcastle-on-Tyne)	Manager
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Carbonization

A.B. Fung	B.Sc. (Waterloo), P.Eng.	Engineer
R. Zrobok	B.Sc. (Alberta)	Phys. Sci.
V. Munoz	B.Sc. (Chile)	EG-ESS
K. McAuley		GL-MOC
W. Silbernagel	B.Sc. (Calgary)	GL-MOC

Fossil Fuel Science and Applications

N.E. Anderson	B.Sc. (Alberta)	Phys. Sci.
W.H. Michaelian	B.Sc. (California), Ph.D. (Simon Fraser)	Res. Sci.
W.M. Leung	B.Sc. (Hong Kong), M.Sc. (Manchester) Ph.D. (McGill)	Res. Sci.
D. Axelson	B.Sc. (Toronto), Ph.D. (Toronto)	Res. Sci.
C.W. Angle	B.Sc. (Alberta)	Phys. Sci.
R. Mikula	B.Sc. (Saskatchewan), Ph.D. (British Columbia)	Phys. Sci.
S. Twa	B.Sc. (British Columbia)	Phys. Sci.
R. Frenette	B.Sc. (Santo Tomas)	EG-ESS

Process Control and Computer Applications

J.L. Picard	B.Sc. (Alberta)	Phys. Sci.
N.A. Mansour	B.Sc. (Cairo), B.Sc. (Alberta) Ph.D. (Alberta)	Res. Sci.
A. Salama	B.Sc. (Alexandria), Ph.D. (Alberta)	Res. Sci.
W. Friesen	B.Sc. (Brock), Ph.D. (British Columbia)	Res. Sci.
A.W.F. Mo	B.Sc. (Alberta)	Phys. Sci.

Coal Preparation (Pilot Plant)

M.W. Mikhail	B.Sc. (Assuit), M.Sc. (Alberta), P.Eng.	Engineer
I.S. Parsons	B.Sc. (Western Ontario)	Phys. Sci.
J. Szymanski	M.Sc. (Wroclaw), Ph.D. (Wroclaw)	Res. Sci.
O. Humeniuk		EG-ESS

Engineering and Field Demonstration

K. Hashmi	B.Sc. (Alberta), P.Eng.	Engineer
Z. Potoczny	B.Sc. (Toronto), M.Sc. (Toronto)	Engineer
M. Hewlett		EG-ESS
T. Klymoc	B.Sc. (Alberta)	EG-ESS
K. Bukka	B.Sc. (Hyderabad), M.Sc. (Hyderabad), Ph.D. (London)	EG-ESS
J. Chu	B.Sc. (Alberta)	EG-ESS
D. Calvert	B.Sc. (Alberta)	EG-ESS
A. Gilbert	Biological Sciences Diploma (N.A.I.T.)	EG-ESS

STAFF CHANGESNew EmployeesEdmonton

Klymoc, T.
Bukka, K.
Chu, J.
Calvert, D.
Gilbert, A.

Calgary

Stevenson, J.

Resignations and Separations

Kuchinski, T.
Deary, T.
Chaing, B.
Vladut, T.
Petre, E.
Calvert, D.
Klymoc, T.
Gilbert, A.
Zhang, P.

Transfers

Stewart, B. (from Cape Breton to Edmonton)

Zahary, G. (from Calgary to Ottawa (RPO))

Visiting Scientists/Fellows

Zhang, P. People's Republic of China

Zuber, G. Luscar Coal Company

Suh, J.S. University of Toronto

Ansari, R. University of Guelph

APPENDIX D: PUBLICATIONS, PRESENTATIONS AND PATENTS

PUBLICATIONS, PRESENTATIONS AND PATENTS

BOOKS

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CONTRIBUTION TO BOOKS

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- Konda, B.W. and Kochhar, J.K. "Longwall Mining under the Ocean at Cape Breton Collieries"; 1985 Mining Convention, American Mining Congress; September 22-25, 1985; San Francisco, California.
- Michaelian, A.M. and Friesen, W.I. "Resolution Enhancement of Photoacoustic FTIR Spectra"; Presented at 1985 International Conference on Fourier and Computerized Infrared Spectroscopy; Ottawa; June, 1985.
- Mikhail, M.W., Mikula, R.J., and Humeniuk, O. "Size Reduction of Friable Coals by Crushing"; Presented at the Engineering Foundation Conference on Science and Technology of Processing Fine Coal; Henniker, New Hampshire, August 11-16, 1985.
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- Picard, J.L., Hasmi, K.A., and Potoczny, Z.M. "CANMET's Mobile Water Treatment Plant: Field Tests at the CNRL Line Creek Washery"; Presented at Second District Five Meeting-CIM; Hinton, Alberta; September 10-13, 1985.
- Salama, A.I.A., Mikhail, M.W., and Shaw, D.L. "Development of a Computer Control for a Heavy Media Circuit"; Proceedings of 13th Annual Mining and Metallurgy Industries Symposium and Exhibit, ISA, Salt Lake City, Utah; May 15-17, 1985.
- Singhal, R., Kolada, R., and Vladut, T. "Productivity and Equipment Selection in Surface Mining of Oil Sands", Society of Mining Engineers of AIME, Fall Meeting, Albuquerque, New Mexico; Paper No. 85-384; October 1985.
- Singhal, R.K. "Mine Planning and Equipment Selection in Coal Mining"; Proceeding of the International Mining Conference - Mining 1985, Birmingham, U.K., June 10-12 1985.
- Singhal, R.K., Stewart, D.B. "Rapid Roadway Drivage in Coal Mining", Proceedings of the Rapid Excavation and Tunneling Conference New York; U.S.A., June 16-20, 1985.
- Singhal, R.K. and Osborne, D.G. "Selective Mining, Homogenization and Blending of Canada's High Sulphur Thermal Coals", Proceedings First International Conference on Processing and Utilization of High Sulfur Coals; Columbus Ohio, U.S.A.; October 13-17, 1985.
- Singhal, R.K. and Golosinski, T.S. "Utilization of Bucket Wheel Excavators: Mining and Geotechnical Factors". Proceedings of the Symposium on "Mine Equipment Selection", University of Calgary, November 7 and 8, 1985.
- Singhal, R.K., and Zahary, G., and Stewart, D.B., and Bacharach, J.P.L. "Alternative Face cutting Systems for Longwall Mining" Society of Mining Engineers of AIME Fall Meeting, Albuquerque, New Mexico, U.S.A., Pre-print No. 85-308, October 16 - 18, 1985.
- Singhal, R.K. and Fytas, K. "Off-Highway Truck Selection in Surface Coal Mining" Proceedings 1985 Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation, Lexington, Kentucky, U.S.A., December 9-13, 1985.
- Srajer, V. "The Computers Modelling of Surface Coal Mining Operation," First IFAC Symposium, Brisbane, Queensland, Australia, July 9-11, 1985.

Srajer, V., Espinoza, R., and Muir, D. "Evaluation of Mine Planning and Scheduling Packages Applicable to Coal Mining in Canada." District Five meeting of CIM, Hinton, Alberta, Canada, September 10-12, 1985.

Stokes, A.W. "Air Leakage Through Longwall Wastes in the Sydney Coalfield"; Presented to and published in the proceedings of the 2nd U.S. Mine Ventilation Symposium; September 23-25, 1985; Reno, Nevada.

Szymanski, J. "Velocity of Wave Propagation in a Dense Coal Water Suspension"; Proceedings of the 10th International Technical Conference on Slurry Technology; Lake Tahoe, Nevada; March 26-28, 1985.

Szymanski, J. and Mansour, N. "Rheological Transient Model of Dense Coal/Water Suspensions"; Proceedings of Seventh International Symposium on Coal Slurry Fuels Preparation and Utilization; New Orleans, Louisiana; May 21-24, 1985.

UNPUBLISHED PRESENTATIONS

Aston, T.R.C. "Potential Instrumentation Schemes for Monitoring Seafloor Subsidence"; Presented at the Bedford Institute of Oceanography, Halifax, N.S.; February 20-21, 1985.

Aston, T.R.C. "Effects of Mining Subsidence on Surface Structures"; Presented to the Undergraduate Mining Class, Mining Department of McGill University; March 22, 1985.

Aston, T.R.C. "Potential Instrumentation Schemes for Monitoring Seafloor Subsidence;" Presented to the Postgraduate School, Mining Department of McGill University; March 22, 1985.

Aston, T.R.C. "Mining and Strata Mechanics Research Activities in the Sydney Coalfield, N.S. - An Overview"; Presented at the NCB Mining Research and Development Establishment, Bretby, U.K.; September 4, 1985.

Aston, T.R.C. "Mining and Strata Mechanics Research Activities in the Sydney Coalfield, N.S. - An Overview"; Presented at the Department of Mining Engineering, University of Nottingham, U.K.; September 6, 1985.

Aston, T.R.C. "Instrumentation Schemes Capable of Measuring Seafloor Subsidence over Longwall Mining Operations"; Presented at the International Mine Water Congress, Granada, Spain; September 20, 1985.

Aston, T.R.C. "A Review of Undersea Mining Subsidence Research in the Sydney Coalfield, N.S."; Presented at a CIM-RMSCC Seminar on Subsidence Due to Soft Rock Mining, Saskatoon; November 15, 1985.

Axelson, D.E. "Solid State NMR of Fossil Fuels"; Presented to CSIRO Division of Fossil Fuels, North Ryde, Australia; August, 1985.

- Axelsson, D.E. "Solid State NMR of Fossil Fuels-Weathering/Oxidation"; Presented to Argonne National laboratory, Argonne, Illinois; September, 1985.
- Das, B. "Note on the Geotechnical Conditions of the Canadian Coalfields", presented to the Mining Engineering Seminar/Course, University of Utah, Salt Lake City, May 1985.
- Das, B. "The Microhardness Technique and its Application to Coal and Coal Mining" presented to the Mining Engineering Seminar/Course, University of Utah, Salt Lake City, May 1985.
- Das, B. "Status of Rock Mechanics Research in Mining" Seminar Presentation, Dept of Geological Engineering, The University of Manitoba, Sept. 25, 1985.
- Cain, P. "Summary of the Effects of Monolithic Pumped Packing at Lingan Colliery"; Presented to the Engineering staff of CBDC at Glace Bay; September 9, 1985.
- Cain, P. and Haslett, G.A. 16 hours of Underground Mining lectures presented to the UCCB Minerals Technology, 2nd year Class; April to June 1985.
- Leung, W.M. "Application of Water Soluble Polymers in Coal Preparation"; Presented to 6th Coal Production and Transportation Working Group Meeting, Edmonton; January 1985.
- Leung, W.M. "Flocculation-Theory and Applications"; Presented to a seminar-workshop for coal industry employees, Devon; February 1986.
- Mansour, N.A. "Microwave Solid State Electronics"; Presented to Electrical Engineering Department, University of Central Florida; February 1985.
- Michaelian, K.H. "Applications of Raman Spectroscopy at CRL Edmonton"; Presented to Department of Physics, University of Guelph; December 1985.
- Mikhail, M.W. "Proposed Plan for Selection of Papers for the 10th International Coal Preparation Congress"; Presented to the International Organizing Committee of the Coal Preparation Congress; Vancouver; May 1985.
- Singhal, R.K. "New Developments in Surface Mining of Coal and Oil Sands" Seminar. Technical University of Nova Scotia, Halifax. April 3, 1985.
- Singhal, R.K. "A Study Guide for a Mini-Course: Mine Planning and Equipment Selection in Surface Mining", College of Engineering, University of Kentucky, U.S.A., December 1985.

Stewart, D.B. "Spontaneous Combustion of Coal and the Problems it Poses for Emergency Responses Workers", Alberta Occupational Health and Safety Division Emergency Response Team Instructor's Conference, Mayfield Inn, Edmonton, Alberta, February 26, 1986.

DIVISIONAL REPORTS

UNCLASSIFIED

ERP/CRL 85-38(INT)	Cape Breton Coal Research Laboratory Annual Report: FY 84-85	D.B. Stewart
ERP/CRL 85-40(J))	Underground Mine Fire Control with Inerting Systems	J.P.L. Bacharach A.L. Craven D.B. Stewart
ERP/CRL 85-42(J,OP)	Evaluation of the Point Load Strength test for soft rock classification	B. Das
ERP/CRL 85-43 (TR)	The Practice of Micro Seismics Monitoring for Mining Activities	T.I. Vladut
ERP/CRL 85-44(IR))	Methane Emission in Longwall Districts with Special Reference to 14 North District of No. 26 Colliery	B.W. Konda
ERP/CRL 85-45(TR)	The truck/shovel mining and operating practices at Highvale in Alberta	V. Srajer
ERP/CRL 85-46(TR)	The time studies of truck/shovel System at Highvale mine in Alberta	V. Srajer
ERP/CRL 85-47(TR)	The model specification of the truck/shovel system at Highvale Mine	V. Srajer
ERP/CRL 85-48(INT)	Report of the Third International Mine Ventilation Congress, Harrogate 1984 and field visits related to mine environmental monitoring systems	R.J. Kolada
ERP/CRL 85-49(OP)	Note on geotechnical conditions of the Canadian Coalfields	B. Das

ERP/CRL 85-50(INT)	Modifications to Irad Gage Flexible Sonic Probe Extensometer Anchors	P. Cain
ERP/CRL 85-51(OP)	The microhardness technique and its application to Coal and Coal Mining	B. Das
ERP/CRL 85-52(IR))	Preliminary Report on the Pump Packing Trial at Lingan Colliery	P. Cain
ERP/CRL 85-53(TR)	Evolution of Coal reserve concept in Canada	H.G. Naidu
ERP/CRL 85-54(TR)	Ultrasonication in the Study of Coal. Part I. A Literature Review.	C.W. Angle H.A. Hamza
ERP/CRL 85-55(TR)	Ultrasonication in the Study of Coal. Part I. A Literature Review.	C.W. Angle H.A. Hamza
ERP/CRL 85-56(OP,J)	Productivity enhancement in surface mining of oil sands.	R.K. Singhal R.J. Kolada T.E. Vladut
ERP/CRL 85-57(OP,J)	Application of Biotechnology for Methane Control in Coal Mines	R.N. Chakravorty P.I. Forrester
ERP/CRL 85-59(OP,J)	Mining planning and equipment Selection in Coal Mining	R.K. Singhal
ERP/CRL 85-60(OP,J)	Air Leakage through Longwall Wastes in the Sydney Coalfield	A.W. Stokes
ERP/CRL 85-61(OP))	Highlights of Recent Research Conducted by the Cape Breton Coal Research Laboratory Coal Mine Environment Group	J.C.Y. Hwang B.W. Konda A.W. Stokes
ERP/CRL 85-62(OP)	Highlights of Recent Research Conducted by the Cape Breton Coal Research Laboratory Advanced Technology Group	G.A. Haslett
ERP/CRL 85-64(INT)	Calgary Coal Research Laboratory 1984-85	R.K. Singhal
ERP/CRL 85-65(TR)	Coal Strength Parameters Derived for the Donkin-Morien Harbour Seam Sydney Coalfield, N.S.	T.R.C. Aston L.S. O'Leary D.A. Young

ERP/CRL 85-66(TR))	The Effect of Monolithic Packing on Gateroad Performance at Lingan Colliery	P. Cain
ERP/CRL 85-67(INT)	Attendance of Water Jet Short Course at the University of Pittsburgh, May 20, 1985; Attendance at the Third U.S. Water Jet Conference at the University of Pittsburgh, May 21-23, 1985 and a Visit to 13's Right Longwall at the Bethlehem Energy Corp. Van Mine, W. Virginia	G.A. Haslett
ERP/CRL 85-69(INT)	Visit to U.K., June 17-20, 1985	G.A. Haslett
ERP/CRL 85-70(INT)	Trip Report: To European Research and Development Organizations & Mining Machinery	R.K. Singhal
ERP/CRL 85-71(TR)	Coal Research Laboratories Annual Progress Report 1984-85	B. Chiang
ERP/CRL 85-72(OP,J)	Analysis of Water Inflows in the Donkin-Morien No. 3 Tunnel, Sydney Coalfield, Nova Scotia	T.R.C. Aston H. MacLeod-LaFosse
ERP/CRL 85-73(OP,J)	Methane Emission and Control at Lingan Colliery	B.W. Konda J. Kochhar
ERP/CRL 85-74(IR)	Initial Strength Development of 'Astrapack' Pump Packing Material	P. Cain
ERP/CRL 85-75(OP)	Sealing Exploration Drillholes: An Essential Part of Mine Planning	H.U. Bielenstein H.A. Anderson T.R.C. Aston
ERP/CRL 85-76(TR)	The Use of SF ₆ to Determine Leakage from an Auxiliary Ventilation Duct in a Long Single Heading	A.W. Stokes
ERP/CRL 85-77(OP,J)	Evaluation of mine planning and scheduling packages applicable to Coal mining in Canada	V. Srajer R. Espinoza D. Muir
ERP/CRL 85-78(TR)	'Durov Plot' Users Guide: Computer Calculation and Plotting of Durov Diagrams for Water Chemistry Analysis	D.A. Young T.R.C. Aston

ERP/CRL 85-79(TR)	Strength Log of an Open Borehole from Index Testing of Cuttings	P. Cain L.S. O'Leary
ERP/CRL 85-80(TR)	An Analysis of Air Leakage through Longwall Wastes in Lingan Colliery	D.M. Hamilton A.W. Stokes
ERP/CRL 85-81(OP,J)	A suggested method for estimating bolt lengths and loadings for support of rectangular openings	B. Das B. Stimpson
ERP/CRL 85-82(OP,J)	Undersea Coal Mining Research	T.R.C. Aston
ERP/CRL 85-83(OP)	Longwall Mining under the Ocean at Cape Breton Collieries	B.W. Konda J.K. Kochhar
ERP/CRL 85-84(TR)	Auxiliary Duct Airflow Determination in Lingan Phalen Using SF ₆	A.W. Stokes
ERP/CRL 85-85(TR)	A Review and Evaluation of Undersea Subsidence Criteria Used in the Sydney Coalfield, N.S.	T.R.C. Aston
ERP/CRL 85-86(OP)	Summary of the Effects of Monolithic Pumped Packing at Lingan Colliery	P. Cain
ERP/CRL 85-87(OP,J)	The development and validation of the truck and shovel computer model	V. Srajer
ERP/CRL 85-88(IR)	The Effect of Monolithic Packing on Gateroad Performance at Lingan Colliery	P. Cain
ERP/CRL 85-89(INT)	Visit Report - Attending Sixth International Mine Surveying Congress, September 9-13, 1985; International Mine Water Congress, September 17-21, 1985 and Technical Visits within the U.K., September 2-6 and 23, 1985	T.R.C. Aston
ERP/CRL 85-91(INT)	Visit Report - Mine Ventilation Services (LaFayette, Ca.), University of California (Berkeley, Ca.), 2nd U.S. Mine Ventilation Symposium (Reno, Ne.)	A.W. Stokes
ERP/CRL 85-93(INT)	ASTM Committee D05 on Coal and Coke: October 1985 Meeting	G.W. Bonnell

ERP/CRL 85-94(TR)	The study of dragline operation at Highvale mine in Alberta	V. Srajer
ERP/CRL 85-95(TR)	Evaluation of Shovel/Loader operation at Highvale Mine in Alberta	V. Srajer
ERP/CRL 85-96(TR)	Initial field application/test of telemetry system to monitor stability at highwall/tailing at oil sands open pit, syncrude Canada, Ft. McMurray".	M.Y. Fisekci N. J. Stuart
ERP/CRL 85-97(OP,J)	Control of Spontaneous Combustion of Coal through an analysis of its mechanism and the affecting factors	B. Das V. J. Hucka
ERP/CRL 85-98(INT)	Computer Course C709 - Data Base Management Systems and Visit Report - CANMET, Ottawa	G.W. Bonnell
ERP/CRL 85-100(J)	The Raman Spectrum of Kaolinite #9 at 21°C	K.H. Michaelian
ERP/CRL 85-101(J)	Resolution Enhancement of Photoacoustic FTIR Spectra	K.H. Michaelian W.I. Friesen
ERP/CRL 85-102(J)	Photoacoustic and Diffuse Reflectance FTIR Spectra of Kaolinite	J.C. Zwinkels J.C. Donini K.H. Michaelian
ERP/CRL 85-103(J)	Near-, Mid-, and Far-Infrared Photoacoustic Spectroscopy	J.C. Donini K.H. Michaelian
ERP/CRL 85-104(TR)	"Evaluation of an underground mine monitoring system"	R.J. Kolada R.N. Chakravorty
ERP/CRL 85-105(J,OP)	Oxidation and Weathering of Stockpiled Western Canadian Coals	R.J. Mikula D.E. Axelson K.H. Michaelian
ERP/CRL 85-106(TR)	A strategy for measuring Off-Highway Rolling Resistance	R.J. Kolada N.J. Stuart
ERP/CRL 85-107(IR)	The Effectiveness of New Tailgate Support Methods at Langan Colliery	S.D. Ross P. Cain
ERP/CRL 85-108(TR)	Truck management systems review	V. Srajer
ERP/CRL 86-1(TR)	State of the Art of Micro Seismic Application in Mining	T.I. Vladut

ERP/CRL 86-2(INT)	Sixth International Congress on Rock Mechanics 1987 - Post Congress Tour Information, Sydney Coalfield, N.S.	T.R.C. Aston
ERP/CRL 86-3(TR)	'Sub #4' Users Guide: Computer Calculation of Longwall Subsidence Profiles Using the NCB Subsidence Engineers Handbook	D.A. Young T.R.C. Aston
ERP/CRL 86-04(TR)	Design Techniques of Digital PI and PID controllers for Linear Discrete-Time Multivariable Systems	A.I.A. Salama
ERP/CRL 86-05(TR)	Design of Linear Continuous Multivariable PID Controller	A.I.A. Salama
ERP/CRL 86-06(TR)	Interfacial Phenomena in Coal Technology. Part I. Surface Characterization of Coal	E.I. Vargha-Butler D.R. Absolom H.A. Hamza A.W. Neuman
ERP/CRL 86-07(TR)	Computer Realization of Spatial Filters	N.A. Mansour
ERP/CRL 86-08(TR)	Density Sensor for Solids Component in Two Phase Flow	J.K. Szymanski
ERP/CRL 86-09(J)	Mathematical Expressions for the Probable Error and Error Areas	A.I.A. Salama
ERP/CRL 86-11(J))	Stability Enhancement of Coal Measures Strata with Water-Based Chemical Agents	P. Cain J.D. Brown J.A. Amirault
ERP/CRL 86-12(TR,J)	Developments in Coal Mine Fire Control	R.N. Chakravorty R.J. Kolada
ERP/CRL 86-13(J,OP)	Off-Highway truck selection in surface coal mining	R.K. Singhal K. Fytas
ERP/CRL 86-14(J,OP)	Alternative face cutting systems for longwall mining	R.K. Singhal G. Zahary D.B. Stewart J.P.L. Bacharach
ERP/CRL 86-15(J,OP)	Productivity and equipment selection in surface mining of oil sands	R.K. Singhal R.J. Kolada T.I. Vladut

ERP/CRL 86-16(IR)	An Investigation into the Effect of Varying Water Pressure and Flow Rates upon the Release of Airborne Respirable Dust by a Dosco MKIIB Roadheader Equipped with a Water Jet Assisted Cutting Head	G.A. Haslett G.R. Corbett D.A. Young
ERP/CRL 86-17(IR)	Some Common Features of Retreat Longwall Panels in Highly Productive Mines	G.A. Haslett D.B. Stewart
ERP/CRL 86-18(IR)	An Appraisal of Flyash Based Monolithic Packing for Use at Lingan Colliery, Nova Scotia	P. Cain
ERP/CRL 86-19(TR)	Technical Evaluation of the 1984 San Francisco AICHE Meeting	N.A. Mansour
ERP/CRL 86-20(J)	Fourier Deconvolution of Photoacoustic FTIR Spectra	W.I. Friesen K.H. Michaelian

CONFIDENTIAL

ERP/CRL 86-21(CF)	Suncor Tailings Pond Upgrading Process Study	R.J. Mikula D.E. Axelson
ERP/CRL 85-39(CF)	Coal Mining in Canada; Recent history, Current Status and Foreseeable Future	A.S. Romaniuk
ERP/CRL 85-41(CF)	Characterization & Demulsification Studies on Oil-in-Water Emulsions	S.P. Twa H.A. Hamza
ERP/CRL 85-58(CF)	Views of the Provincial/Territorial Mines Inspectorates on the Subject of a Canadian Mine Rescue Centre	D.B. Stewart
ERP/CRL 85-63(CF)	Statistical Review of Compliance Dust Sampling Results in Three Eastern Canadian Underground Coal Mines for the Period 1975-1983	J.C.Y. Hwang D.B. Stewart
ERP/CRL 85-68(CF)	Respirable Dust Measurements Made at Lingan Colliery during the Period December 1984-March 1985: Part I	J.C.Y. Hwang D.J. Kennedy G.W. Bonnell

ERP/CRL 85-90(CF)	A Review and Evaluation of Under-sea Subsidence Criteria Used for the Donkin-Morien Definition Study	T.R.C. Aston
ERP/CRL 85-92(CF)	Determination of Langan Colliery Main Fan's Operating Point	A.W. Stokes D. Genter
ERP/CRL 85-99(CF)	Evaluation of Processed Rosebud Coal	D. Axelson V.A. Munoz R.J. Mikula K.H. Michaelian W.M. Leung
ERP/CRL 86-21(CF)	Suncor Tailings Pond Upgrading Process	R.J. Mikula D.E. Axelson



APPENDIX E: REPRESENTATION ON TECHNICAL COMMITTEES

INTERNATIONALCo-operative Agreement on Coal Slurry Pipeline with West Germany

Co-ordinator T.D. Brown
 Project leader/contact M.W. Mikhail

Eighth International Strata Control Conference Organizing Committee

Canadian representative D.B. Stewart

Institution of Mining and Metallurgy (U.K.)

Mining Industry Editorial Advisory Board R.K. Singhal

International Journal of Mine Water

Canadian Editor T.R.C. Aston

Tenth International Coal Preparation Congress (1986)

Steering Committee (member) T.D. Brown
 Foreign Languages Committee (chairman) A.S. Romaniuk
 Technical Program Committee (chairman) M.W. Mikhail

World Mining Equipment

Editorial Advisory Board R.K. Singhal

CANADA - FEDERALAdvisory Committee for Canada-Saskatchewan Project on Pipelining of Heavy Crude Oils

Member M.W. Mikhail

CANMET - The Mineral and Metal Recovery Biotechnology Research Network (BIOMINET)

CRL: representative R.N. Chakravorty

Transport Canada

Steering Committee on Coal Slurry Pipeline Transport.. M.W. Mikhail
 (secretary, member) J. Szymanski

Tunnel Boring Machine Joint Review Board

EMR representative D.B. Stewart

CANADA - MISCELLANEOUSAlberta/Canada Energy Resource Research Fund

EMR representative T.D. Brown

Atlantic Coal Institute

Director T.D. Brown

Canadian Institute of Mining and Metallurgy (CIM)Coal Division

CAPCC (representative) B. Das
 Coal Preparation Section-Program Committee (secretary
 member) M.W. Mikhail
 Publications Committee (member) A.S. Romaniuk
 Steering Committee (member) A.S. Romaniuk
 Technical Program Committee A.S. Romaniuk
 Technical Program Committee G. Zahary

Computer Application and Process Control Committee (CAPCC)

(chairman) B. Das
 Member Executive Committee as Past Chairman B. Das
 Publication (chairman) B. Das

Coal Mining Research Centre

Technical Committee-Coal Preparation (member) M.W. Mikhail

Coal Preparation Research Association of Canada

Secretary M.W. Mikhail

Committee on Atlantic Coal

CANMET representative	T.D. Brown
Coal Mining Working Group (chairman)	D.B. Stewart
Coal Mining Working Group (members)	G.A. Haslett
	R.K. Singhal
	G. Zahary

Frictional Ignition Working Group

Chairman D.B. Stewart
Member and Secretary G.A. Haslett

Rock Mechanics and Strata Control Committee

(member)	D.B. Stewart
Education and Research Subcommittee	
(member)	D.B. Stewart
Instrumentation Subcommittee	
(member)	P.R.M. Cain
Rock Bursts and Microseismic Systems Subcommittee	
(member)	P.R.M. Cain
Sedimentary Structures and Subsidence Subcommittee	
(member)	T.R.C. Aston

University College of Cape Breton

Mineral Technology Advisory Committee (chairman) D.B. Stewart

University of Alberta

Faculty of Graduate Studies and Research

Examining Committee (member) B. Das

Youth Science Foundation

Science Lecture Program R.K. Singhal

**APPENDIX F: RESEARCH CONTRACTS, RESEARCH AGREEMENTS
AND COST RECOVERY ACTIVITIES**

CAPE BRETON COAL RESEARCH LABORATORY

<u>Title</u>	<u>Investigator</u>	<u>Scientific Authority</u>	<u>Status</u> <u>March 31/86</u>
Overcoming and Minifracing In Situ Stress Determinations at the Langan and Prince Mines, Sydney Coalfield, N.S.	Golder Associates Toronto, Ont.	T.R.C. Aston	Continuing
Evaluation of Grout Filled Lightweight Tubular Steel as an Alternative to Conventional Support in Large Excavations in Coal Mines or Other Places Subject to High Stress	Technical University of Nova Scotia Halifax, N.S.	P. Cain (G.A. Haslett)	Continuing
Calibration of Cone Indentor to Traditional Uniaxial Compressive Strengths of Carboniferous Strata in the Sydney Coalfield	University College of Cape Breton Sydney, N.S.	P. Cain	Completed
Stabilisation of Coal Measures Strata with Water Based Chemical Agents, Part II	Jacques Whitford and Associates Ltd. Halifax, N.S.	P. Cain	Completed
Non Combustible Replacement Materials, Methods and Techniques to Reduce the Usage of Wood in Underground Coal Mines	Jacques, Whitford and Associates Ltd. Halifax, N.S.	G.A. Haslett	Completed
Investigation of the Potential Benefits, Advantages, Disadvantages, and Health/Safety Risks Associated with the Introduction of Water Jet and Jet Assisted Cutting Technology in Underground Coal Mines	International Energy Agency London, U.K.	G.A. Haslett	Continuing

<u>Title</u>	<u>Investigator</u>	<u>Scientific Authority</u>	<u>Status</u> <u>March 31/85</u>
Determination of the Mineralogical and Elemental Composition of Airborne Dust from Underground Coal Mines	Dieter Birk and David O'Neil Atlantic Coal Institute Sydney, N.S.	J.C.Y. Hwang	Completed
A Detailed Review and Evaluation of Methane Prediction Techniques and their Applicability to Canadian Coal Mines	Norwest Resource Consultants Ltd. Calgary, Alta.	B.W. Konda	Completed
Feasibility of Using Gaspills and other Methods of Remotely Measuring Methane in Coal Mines and Preparation of a Conceptual Design for a Suitable Instrument	Moniteq Ltd. Concord, Ont.	B.W. Konda	Completed
Design and Construction of an Apparatus to Conduct Methane Gas Studies on Canadian Coals	Zenon Environmental Inc. Burlington, Ont.	B.W. Konda	Continuing
Operational Experience with the Conspic Remote Environmental Monitoring System in an Operating Underground Canadian Coal Mine	Cape Breton Development Corporation Sydney, N.S.	B.W. Konda	Continuing

CALGARY COAL RESEARCH LABORATORY

<u>Title</u>	<u>Investigator</u>	<u>Scientific Authority</u>	<u>Status</u> <u>March 31/85</u>
Detailed Study of the Reaction Mechanism of Spontaneous Combustion of Coal with Particular Emphasis on Western Canadian Low Rank Coals	Dr. F.W. Bachelor Faculty of Science University of Calgary	R.N. Chakravorty	Completed
Biological Control of Methane in Coal Mines, Coal Storage Silos and Ship Holds - Phase III	Gemini Biochemical Research Ltd. Calgary, Alberta	R.N. Chakravorty	Completed
Analytical Approach to Design of Pillars in Coal - Phase III	Coal Mining Research Centre Devon, Alberta	B. Das	Completed
The Behaviour and Design of Roofs Supported by Non-Tensioned Resin Bolts	Dr. B. Stimpson University of Alberta/ University of Manitoba	B. Das	Completed
Development and Production of a Coal Map File of Canadian Coalfields	Golder Associates (Western Canada) Ltd. Vancouver, B.C.	H.G. Naidu	Completed
Field adaptation of Telemetry Instrumentation in Surface Oil Sands	Ecological Resources Consultants Limited Fredericton, N.B.	M.Y. Fisekci	Completed
Investigation of Computer Software and Hardware in Surface and Underground Mining in Canada (START Program)	H.A. Simons (International) Ltd. Vancouver, B.C.	V. Srajer R. Boyle	Completed
Multiple Block Plane Shear Slope Failure: Theoretical Analysis and Document Case Histories	Coal Mining Research Devon, Alberta	N.J. Stuart	Completed

<u>Title</u>	<u>Investigator</u>	<u>Scientific Authority</u>	<u>Status</u> <u>March 31/85</u>
Application of Conventional Mining Techniques to Underground Oil Sands Mining	Cominco Engineering Services Ltd. Calgary, Alberta	G. Zahary	Completed
A Review of Unconventional Coal Mining Concepts with Potential for Application in Western Canada	Monenco Consultants Ltd. Calgary, Alberta	G. Zahary (R.J. Kolada)	Completed Completed
Application of Geophysical Techniques in Oil Sands	Terracon Geotechnique Leduc, Alberta	G. Zahary (N.J. Stuart)	Completed
Development of Design Criteria for Steeply Dipping Footwall Stability in Mountain Regions.	Hardy Associates (1978)	R.K. Singhal	Continuing
Survey of Methane Accumulation Within Coal Silos	Associated Mining Consultants Ltd.	R.J. Kolada	Completed
KIMONTON COAL RESEARCH LABORATORY			
Further Development, Testing and Application to Coals and Clays using a Conical Fluidised Bed	J.C. Donini St. Francis Xavier University University of Calgary	W.I. Friesen	Continuing
Design and Implementation of Heavy Media Density Control System	Swan Wooster Consultants Ltd.	A.I.A. Salama	Completed

<u>Title</u>	<u>Investigator</u>	<u>Scientific Authority</u>	<u>Status</u> <u>March 31/85</u>
Development of an On-Line Nonradioactive Electromagnetic Density Meter	Northern Unconventional Power	N. Mansour	Continuing
Design and Development of a Fine Coal Cleaning Mobile Plant	Fenco Engineers Inc.	J.K. Szymanski	Completed
Treatment of Bitumen/Oil Emulsions and Effluent Waters	University of Waterloo	N. Mansour	Completed
A Study of Aggregation of Polymers of the Fine Solid Particles in Tailings Slurries	S. Levine	W.I. Friesen	Completed
Development of Analytical Methods for the Determination of Residual Polyacrylamide Polymers in Coal and Process Waters	Guelph Chemical Laboratories Ltd.	W.M. Leung	Completed
A Critical Review of the Light Scattering Technique in the Determination of Oil/Water Interfacial Tensions	T. Craig University of Guelph	W.M. Leung	Completed
The Moisture Resorption Characteristics of Thermal Cried Coal	Coal Mining Research Centre	W.M. Leung	Continuing
Analysis of Aqueous Emulsions of Bitumens and of Polymer Additives in Process Water using Cylindrical Internal Reflectance F.T.I.R. Spectroscopy	B.M. Lynch St. Francis Xavier University	K.H. Michaelian	Continuing

KIMONTON COAL RESEARCH LABORATORY

<u>Title</u>	<u>Investigator</u>	<u>Scientific Authority</u>	<u>Status</u> <u>March 31/85</u>
Water Analysis of Coal Washery Products	Enviro-Test Laboratories	I.S. Parsons S. Twa	Continuing
Coal Analysis of Coal Washery Products	Loring Laboratories Ltd.	I.S. Parsons	Continuing
Characterization of Canadian Magnetite Resources for Optimum Utilization in Coal Heavy Medium Processes	Kilborn Engineering (B.C.) Ltd.	M.W. Mikhail	Completed
Development and Design of Pilot Scale Deep Cleaning Facilities	Kilborn Engineering (B.C.) Ltd.	M.W. Mikhail	Continuing
Evaluation and Testing of Westar Mining Ltd.'s Coal to Determining its Suitability for Coal Water Mixture Combustion	Westar Mining Ltd.	J.K. Szymanski	Completed
Surface Tension Effects on Properties of Coal Suspensions	A.W. Neumann	H.A. Hamza	Completed



APPENDIX G: CONTACTS, MEETINGS AND FIELD TRIPS

CAPE BRETON COAL RESEARCH LABORATORY

Discussion with Cape Breton Development Corporation (CBDC) staff has remained during the year a normal day-to-day event as have visits to CBDC mines by CBCRL staff.

The comparative isolation of CBCRL relative to other CANMET and CRL facilities predicates a requirement that scientists must travel to other parts of Canada, the U.S. and Western Europe to present papers, to exchange information and to discuss ongoing research with other scientists. Such travel serves to keep CBCRL staff abreast of relevant developments elsewhere and avoids duplication of effort.

Two examples from among a number during the past year, will serve to illustrate the principle. A scientist from this Laboratory organized a visit to the U.K. of CBDC engineers and a representative from a local engineering company. The purpose of the visit was to examine the performance of a novel monolithic pump packing system that is capable of using materials indigenous to the Maritime provinces that have suitable high strength characteristics.

An exchange visit was also arranged for a scientist to work for three months at CERCHAR's Laboratoire du Mecanique des Terrains at Nancy, France with intent to improve our knowledge on European roadway support methods with wood replacement materials. Wood replacement is a vital component in the reduction of the risk of fire in underground coal mines.

The relevance of CBCRL programs to industry needs is assured by frequent formal and informal contact during all phases of each project. Laboratory staff participate in or lead a number of informal technology-specific working parties that serve as a fertile spawning ground for research ideas. They are also lively participants in day-to-day CBDC technical problem solving discussions. These discussions coupled with the frequent visits to CBDC mines ensure that laboratory staff remain up to date and aware of developments within the mines of their main client.

EDMONTON COAL RESEARCH LABORATORY

The mobile pilot plants operated by the Edmonton laboratory demand frequent extended field visits by staff to the operating coal preparation plant of western Canada; this maintains an awareness by the engineering staff of the problems of industry. These continuing efforts were extended to Nova Scotia during 85/86 when the initial and planning meetings for field work at the Victoria Junction plant of CBDC were held.

Essential contacts with researchers and technology developments in continental North America and abroad was maintained through a series of selected visits. Following presentation of two papers at the IEA sponsored Basic Coal Science Conference in Australia the head of the Fossil Fuels Research Group was able to review research programs in coal preparation at two major Australian research centres; CSIRO and ACIRL. Senior managers and scientific staff of the laboratory represented EMR in both the Eighth Consultative Meetings on Science and Technology (Bonn, Germany) and the subsequent joint meeting of the Canada/Germany joint Coal Slurry Working Group meetings in Devon, Alberta.

Research contracts associated with the in-house programs continue to lead to consultation with researchers to ensure adequate integration of contractors efforts with the progress of experimental R & D in the laboratory. Several of the laboratories cost-recovery programs have required travel and technical discussions during their initiation and also for final reporting purposes. Notably, one industrial research sponsor invited CRL staff to participate in an on-site review of a demonstration plant for coal upgrading and to join the development of a major feasibility study.

CALGARY COAL RESEARCH LABORATORY

Calgary CRL completed another year of successful co-operative research with industry during which regular contacts were maintained with officials of the mine operations. Several visits were made to western

Canadian coal and oilsands mines to collect field data which has been analyzed and reported. Two of these visits were made at the request of mine managements seeking advice on spontaneous combustion.

Regular contacts were maintained with the Alberta Occupational Health and Safety Division, Coal Association of Canada, Energy Resources Conservation Board, other Provincial Inspection Branches, AOSTRA and western Canadian Universities. CRL scientists gave courses and organized seminars at Universities in Canada and U.S.A. The staff participated actively in the meetings of CIMM, Society of Mining Engineers and a number of their papers were presented at conferences in Canada, U.S.A. and abroad. Many of these papers have been published in national and international journals. Several staff members served on National and International committees and editorial boards of professional societies and technical publications.

Calgary CRL even with its limited resources, provided sound technical services to the mining industry. The scientists and engineers keep abreast of the developments in mining technology elsewhere in the world and endeavour to introduce them in Canada.

